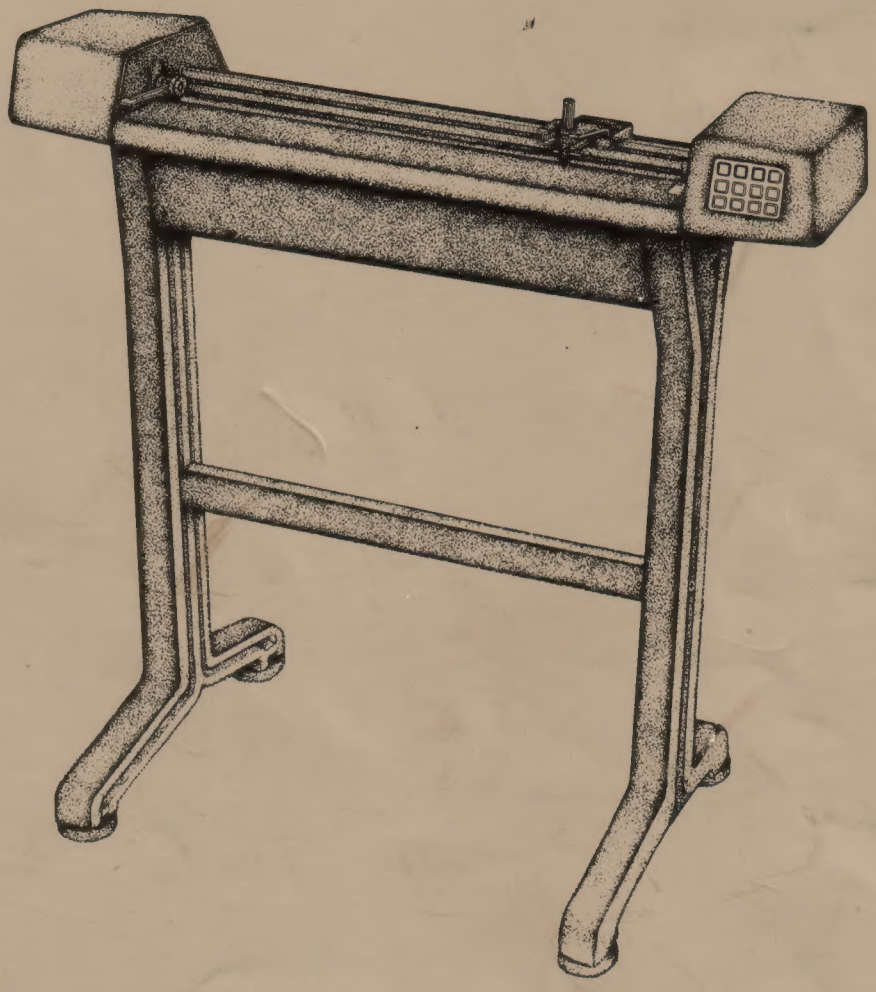
HIPLØT® DMP-51/52

OPERATION MANUAL



houston instrument

PLOTTING

A1

MAX SIZE

864, 546

(841, 594)

A2 SIZE

594 ; 420

FOR DMP PLOTTER

- BAUD 9600 (9600)
- 7 DATA BITS (7)
- EVEN PARITY (e)
- ONE STOP BIT (1)
- XON / XOFF PROTOCOL

MODE Com3: 9600, e, 7, 1,

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WARNING

This equipment generates and uses low level radio frequency energy for timing and control purposes. It can radiate frequency energy. If the equipment is not installed and used in accordance with the Operator's Manual, it could cause interference to radio communications. Sample units have been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J or Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a business, commercial, or industrial environment.

Operation of this equipment in a residential area is likely to cause interference, in which case the user, at their own expense, will be required to take whatever measures may be necessary to correct the interference.

LIMITED WARRANTY

Limited warranty extended to the purchaser is: HIPLØT® products are guaranteed against defects in material and workmanship for a period of 90 days from the date purchased by the customer. Liability under this warranty is limited to repair, adjustment, or replacement under the provisions listed A and B. Customer shall provide proof of purchase data.

Arrangements for warranty service:

1. Contact the Houston Instrument Service Department (toll-free inside Texas: 800-252-8008, toll-free outside Texas: 800-624-4786) and request a Return Authorization Number.
2. Write the Return Authorization Number on the outside of the shipping box.
3. Return the equipment to the Houston Instrument Service Department at 8500 Cameron Road, Austin, Texas 78753.

Warranty provisions:

A. Defective instruments will be returned to Houston Instrument where they will be repaired at no charge to the customer. Houston Instrument will be responsible for the freight charges only in returning the instrument to the customer.

B. Defective parts may be returned to Houston Instrument and these parts will be replaced at no charge other than shipping fees.

No other warranty, expressed or implied, is given. This warranty is void if the instrument is not used according to the instruction manual; if operated under adverse environmental conditions; if tampered with, modified, or repaired by unauthorized personnel; or if used with other than approved supplies. Houston Instrument is not responsible for consequential damages.

Houston Instrument reserves the right to change any information contained in this manual without notice.

Please address questions, comments, or suggestions concerning this manual to:

Houston Instrument
Technical Publications
8500 Cameron Road
Austin, Texas 78753

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GENERAL INFORMATION

1.1 INTRODUCTION

Houston Instrument has merged the lightning speed of the incredibly accurate servomotor with the high level of DM/PL™ intelligence to create the newest additions to its HIPLØT® product line — the DMP-51 and DMP-52 Drum Plotters. Not only will you find these new products smart, but durable because each device reflects the high standard of craftsmanship developed during the years of recorder production at Houston Instrument.

This manual contains the operating instructions for both the DMP-51 and DMP-52 Plotter models. These Plotters are operationally identical, the only difference is in the sizes of paper used. In the remainder of this manual, the term "Plotter" is used to describe characteristics common to both devices. The terms "DMP-51" or "DMP-52" are used to describe unique characteristics of that particular model.

A few of the features you'll find on your Plotter are:

- DM/PL software protocol,
- Serial RS-232-C interface capabilities,
- Membrane Control Panel switches,
- English or metric scaling,
- .001″, .005″, .1 mm, or .025 mm user addressable resolution,
- A Menu mode, which allows you to select the Plotter's power-up operating configuration,
- An extensive Self-Test capability,
- Window and scaling capabilities for "clipping" plots and graphs,
- Plotter-to-computer Report capabilities,
- Eight different sets of character styles which can be produced in 255 different sizes, rotated to any slope, and printed in italics,
- 15 different axial plotting speeds which can be selected in one inch/second increments (2—16 ips or 5—40 cm/sec),
- and more!

DM/PL is a trademark of Houston Instrument.

This manual:

- Shows you how to set up and manually operate the Plotter in local mode,
- Shows you how to interface the Plotter with your computer systems and,
- Describes your Plotter's DM/PL capabilities.

1.2 SPECIFICATIONS

ITEM	DESCRIPTION
PLOTTER:	
Overall Height	36.5 inches (92.71 cm).
Width (DMP-51)	32 inches (81.3 cm).
Width (DMP-52)	32.12 inches (81.6 cm).
Depth	8 inches (20.3 cm).
Stand Base	16 inches (40.6 cm).
Weight	32 pounds (14.4 kg).
Shipping Weight	37 pounds (16.7 kg).
Maximum Plot Size (DMP-51)	15 × 20 inches (38.1 cm × 50.8 cm) or 20 × 32 inches (50.8 cm × 81.3 cm).
Maximum Plot Size (DMP-52)	14.5 × 21.5 inches (36.8 cm × 54.6 cm) or 21.5 × 32 inches (54.6 cm × 81.3 cm) or 21.5 × 34 inches (54.6 cm × 86.4 cm).
PLOTTING MATERIALS:	
Paper Size (DMP-51)	17 × 22 inches (C size) (43.2 × 55.9 cm) or 22 × 34 inches (D size) (55.9 × 86.4 cm).

SECTION 1
GENERAL INFORMATION

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PLOTTING MATERIALS:	
Paper Size (DMP-51)	17 × 22 inches (C size) (43.2 × 55.9 cm) or 22 × 34 inches (D size) (55.9 × 86.4 cm).

Paper Size (DMP-52)	16.5 × 23.4 inches (A2 size) (42 × 59.4 cm) or 23.4 × 33.1 inches (A1 size) (59.4 × 84.1 cm) or 24 × 36 inches (architectural) (61 × 91.4 cm).
Pens	Disposable technical pen.
Media	Frost Brite paper or vellum.

INTERFACE:

Interface Capability	Asynchronous serial RS-232-C.
Plotter I/O Connector	Rear RS-232-C DB-25P.
Mating Connector	RS-232-C DB-25S.
Byte Format	7 data bits, 1 parity bit (selectable) 2 stop bits.
Baud Rate	300, 600, 1200, 2400, 4800, or 9600.
Firmware	DM/PL compatible.

ENVIRONMENTAL:

Operating Temperature	32° to 95° F. (0° to 35° C.)
Relative Humidity	5% to 95%

PERFORMANCE:

Accuracy	On double-matte polyester film (3 mil) at 18-30° C., .1% of move or .5 mm (0.0196''), whichever is greater.
Plotting Speed maximum	16 ips axial (40 cm/sec.). 22 ips diagonal (55.8 cm/sec.). (2 to 16 ips, selectable for English, 5 to 40 cm/sec., selectable for metric).
Pen Up/Down Acceleration	0.5G, 1G, 2G, 3G, or 4G (selectable)
Addressable Resolution	.001", .005", .1mm, or .025 mm
Repeatability	± 0.002 inch (0.050 mm).

POWER REQUIREMENTS:

Input	100/120/220/240 VAC (±10%), 50-60 Hz.,single phase, 60 watts.
Fuse Ratings	1.0AMP SLO-BLO at 100/120 VAC, 0.5 AMP SLO-BLO at 220/240 VAC.

1.2.1 Supplies

NOTE

Houston Instrument is constantly researching and testing its approved line of supplies for your Plotters. Your Plotter cannot produce the high quality plots that it is capable of if inferior pens, inks, and charts are installed.

The following supplies are available from your local dealer.

MISCELLANEOUS

Part No.	Description
DMP41-51	DMP-51 Dust Cover
DMP42-4	DMP-52 Dust Cover
DMP40-303	Drum Grit Wheel Cleaning Strips
MI-1029	DMP-51/52 Operator's Manual
MI-1044	DM/PL Command Language Manual

DISPOSABLE DRAFTING PENS (Requires MA-15 Adaptor)

MA-15	Adaptor
MP-729	Red,Fine point (approx. .35 mm)
MP-730	Blue,Fine point (approx. .35 mm)
MP-731	Black,Fine point (approx. .35 mm)
MP-732	Green,Fine point (approx. 35 mm)
MP-737	Red,Broad point (approx. .70 mm)
MP-738	Blue,Broad point (approx. .70 mm)
MP-739	Black,Broad point (approx. .70 mm)
MP-740	Green,Broad point (approx. .70 mm)
PK-8097	KIT — One each of black, red, blue, green pens, Fine point MA-15 adaptor

DRAFTING SUPPLIES

MP-602	Mounting adaptor and pen body without pen tip

DRAFTING PEN TIPS

MP-659	.35 mm tungsten plotting tip
MP-660	.50 mm tungsten plotting tip
MP-661	.70 mm tungsten plotting tip

DRAFTING INK (One Ounce Bottles)

MI-117	Blue — slow drying
MI-118	Red — slow drying
MI-119	Green — slow drying
MI-121	Blue — fast drying
MI-122	Red — fast drying
MI-123	Green — fast drying
MI-288	Black — all purpose

PAPER (50 SHEETS PER BOX)
VELLUM (50 SHEETS PER BOX)

PART NO.	TYPE	SIZE	FORMAT
MC-3175	VELLUM	22 × 34	LARGE
MC-3176	VELLUM	17 × 22	SMALL
MC-3221	FROST BRITE PAPER	22 × 34	LARGE
MC-3222	FROST BRITE PAPER	17 × 22	SMALL

ARCHITECTURAL-SIZE CHARTS FOR DMP-52:

PART NO.	TYPE	SIZE	FORMAT
MC-3187	VELLUM	24 × 36	LARGE
MC-3220	FROST BRITE PAPER	24 × 36	LARGE

NOTE

New charts for your Plotter are packaged in airtight plastic wrappings. After opening a package, let the charts sit for at least 15 minutes before using. This allows the charts to stabilize to the surrounding humidity.

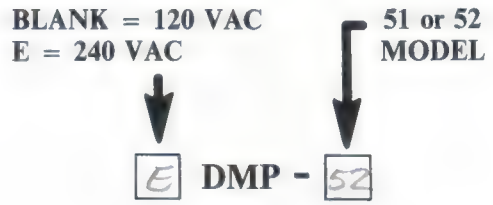
1.2.2 Model Numbering System

The following diagram shows the model numbering system used for the DMP-51 and DMP-52 Plotters. The model of your Plotter is printed on the label located on the bottom panel of the unit.

1.3 MOUNT STAND ASSEMBLY

CAUTION

DO NOT OPERATE THE PLOTTER until it has been secured to the mount stand. DO NOT CONNECT THE POWER SOURCE to the Plotter when the unit is not attached to its mount stand. Otherwise, damage to the Plotter or the plotting materials can result.



The assembly instructions for the mount stand are included in the mount stand kit. Complete the stand assembly and attach the Plotter to it before proceeding with this manual.

1.4 REAR PANEL CONTROL COMPONENTS

Read through the following descriptions of the rear panel controls and components and familiarize yourself with the Plotter. The location of each component is illustrated in Figure 1-1.

(1) RS-232-C PORT CONNECTOR: This DB-25P connector is the communication link between the Plotter and a host computer. Interface instructions are listed in Section 1.9.

(2) POWER SWITCH: This toggle switch turns the Plotter's power on and off.

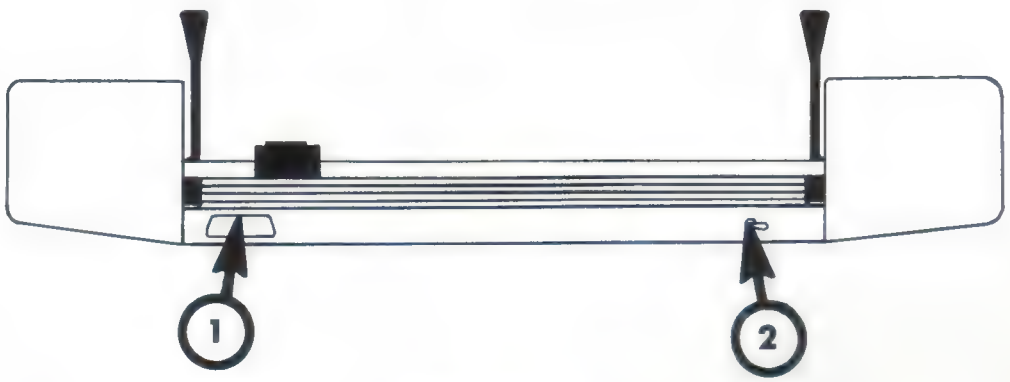


FIGURE 1-1
REAR VIEW OF PLOTTER

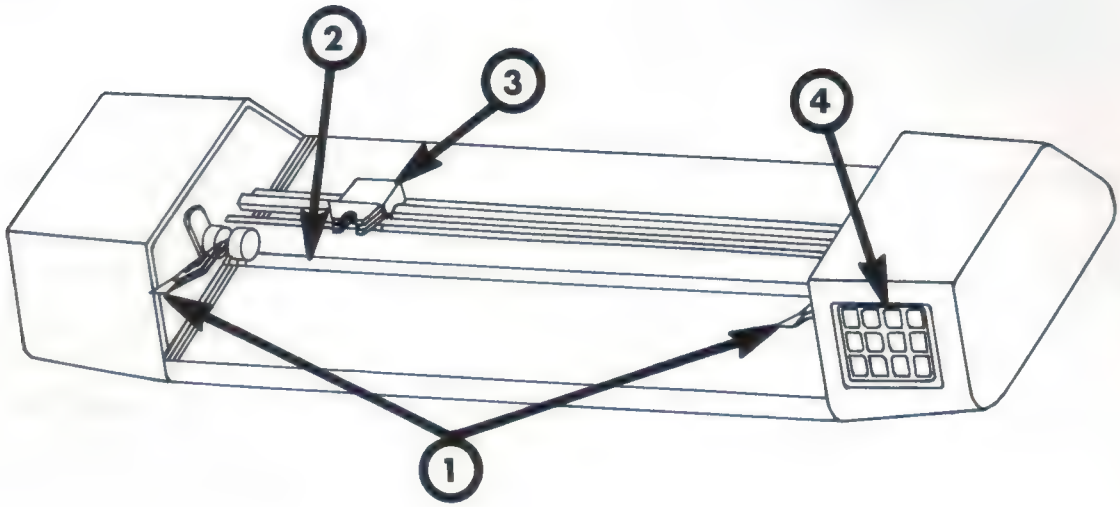


FIGURE 1-2
FRONT VIEW OF PLOTTER

1.5 FRONT PANEL CONTROL COMPONENTS

Read through the following descriptions of the front panel controls and components and familiarize yourself with the Plotter. The location of each component is illustrated in Figure 1-2.

(1) PINCH ROLLER LEVER ARMS: These two levers are used to raise and lower the pinch rollers from the paper drive shaft during paper loading. (Paper loading is discussed in Section 1.7.)

(2) PAPER DRIVE SHAFT: When the Plotter is operated in LARGE chart format, this shaft drives the paper in the X direction. When the Plotter is operated in SMALL chart format, the shaft drives the paper in the Y direction. (LARGE and SMALL chart formats are discussed in Section 1.7.) The drive shaft moves the paper only when the pinch rollers are lowered to the shaft.

(3) PEN HOLDER: The Pen Holder is a mount for the Plotter's pen. The Pen Holder is secured to the beam and moves the pen in the Y direction when the Plotter is operated in LARGE chart format and in the X direction when the Plotter is operated in the SMALL chart format. Section 1.8 explains how to install pens in the Pen Holder.

(4) CONTROL PANEL: The Plotter's Control Panel consists of 12 membrane (switch) touch buttons and four illuminating (on/off) indicators. All Plotter activity must be initiated from the Control Panel functions. This includes initiating remote mode for computer control, local mode for manual operation of the pen and paper, Menu mode, and selecting Window and Scale Box limit coordinates. Each Control Panel function is explained in Section 2.

1.6 POWERING UP THE PLOTTER

DO NOT ATTACH THE POWER CORD to the Plotter or to the AC wall outlet until you have determined the Plotter's operating voltage setting (100, 120, 220, or 240 VAC). To check the voltage setting, look through the bottom panel Fuse Cavity window at the number on the Voltage Select board (see Figure 1-3). This number will be either 100, 120, 220, or 240 and represents the Plotter's voltage setting. If the number does not match the rating of your AC outlet, turn to Section 4.2, "Operating Voltage Conversion," and change the voltage setting and fuse rating before powering up the Plotter.

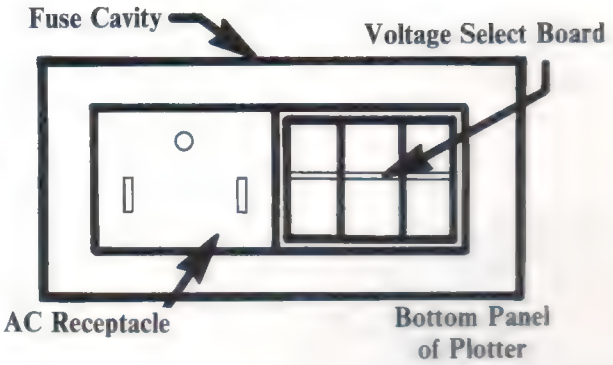


FIGURE 1-3
PLOTTER'S OPERATING VOLTAGE SETTING

To power up the Plotter:

1. With the Plotter properly secured to its mount stand, connect one end of the power cord to the Plotter's bottom panel AC receptacle, which is next to the Fuse Cavity.

TABLE 1-1
FIXED AND MENU-SELECTABLE
DEFAULT VALUES

DEFAULT VALUE	TYPE
Plotter deselected	fixed
State 0 active	fixed
Maximum Window limits	fixed
Maximum Scale Box limits	fixed
Horizonal text path	fixed
Character size 8	fixed
Italics off (text)	fixed
Character set (G0*)	Menu-selectable
Baud rate (2400*)	Menu-selectable
Handshake RTS/DTR (toggle*)	Menu-selectable
UART parity (bit 8 = 0*)	Menu-selectable
Addressing resolution (.001"*)	Menu-selectable
Chart size (LARGE*)	Menu-selectable
Pen Pause (no pause*)	Menu-selectable
Pen Up velocity (16 ips*)	Menu-selectable
Pen Down velocity (16 ips*)	Menu-selectable
Pen Up acceleration (4G*)	Menu-selectable
Pen Down acceleration (2G*)	Menu-selectable
Pen Down Delay (40ms*)	Menu-selectable
Pen Up Delay (20ms*)	Menu-selectable
Pass-Thru port option (toggle*)	Menu-selectable

*This default value was selected at the factory. If this value is not suitable for your applications, you can change the value as explained in Section 2.5.

2. Connect the other end of the power cord to the AC wall outlet.

3. Set the rear panel power switch to ON.

The Plotter has two types of power-up default values—fixed and Menu-selectable (see Table 1-1). A fixed default value is a variable which can be changed to another value after the Plotter has been turned on, but will reset after the power is turned off. A Menu-selectable default value is a variable which can be changed to another value after the Plotter has been turned on, but will *not* reset after the power is turned off. By using the Plotter's Menu-selectable default values, you can personalize your Plotter's power-up operating configuration. Section 2.5 explains how to specify Menu-selectable default values.

The Plotter's ground circuitry protects you from electrical shock. However, this protection is effective only if the AC outlet you use is properly grounded to earth. Always verify an AC outlet's earth ground before using it. If the Plotter is to be connected to a two-contact wall outlet, a 3/2 adapter with grounding lug/wire may be used. This type of connection is illustrated in Figure 1-4.

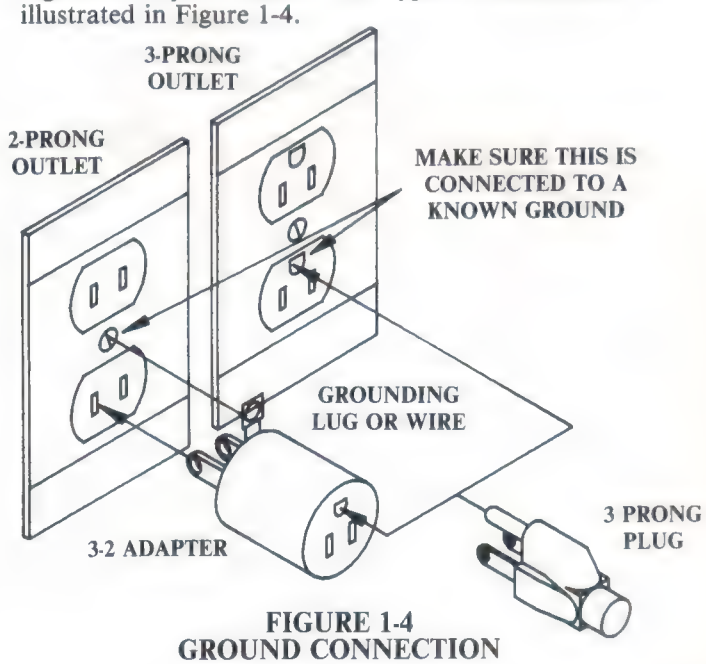


FIGURE 1-4
GROUND CONNECTION

CAUTION

When using the power switch to reset the Plotter manually (ON to OFF to ON), wait at least five seconds before turning the power from OFF to ON. Otherwise, the Plotter may jam (all LEDs on and the Plotter does not respond to the Control Panel switches). If a jam occurs, normal operation can be restored by turning the Plotter's power off for at least five seconds, and then turning the power on.

NOTE

Read the remainder of this manual and follow its instructions before attempting to operate the Plotter.

1.7 PAPER LOADING

The paper for your Plotter is packaged in airtight plastic wrapping. After opening the package, let the paper sit for at least 15 minutes before using. This allows the paper to stabilize to the surrounding humidity. Handle the paper by its edges only! Fingerprints leave a slight residue on the paper which may cause the pens to skip over those areas.

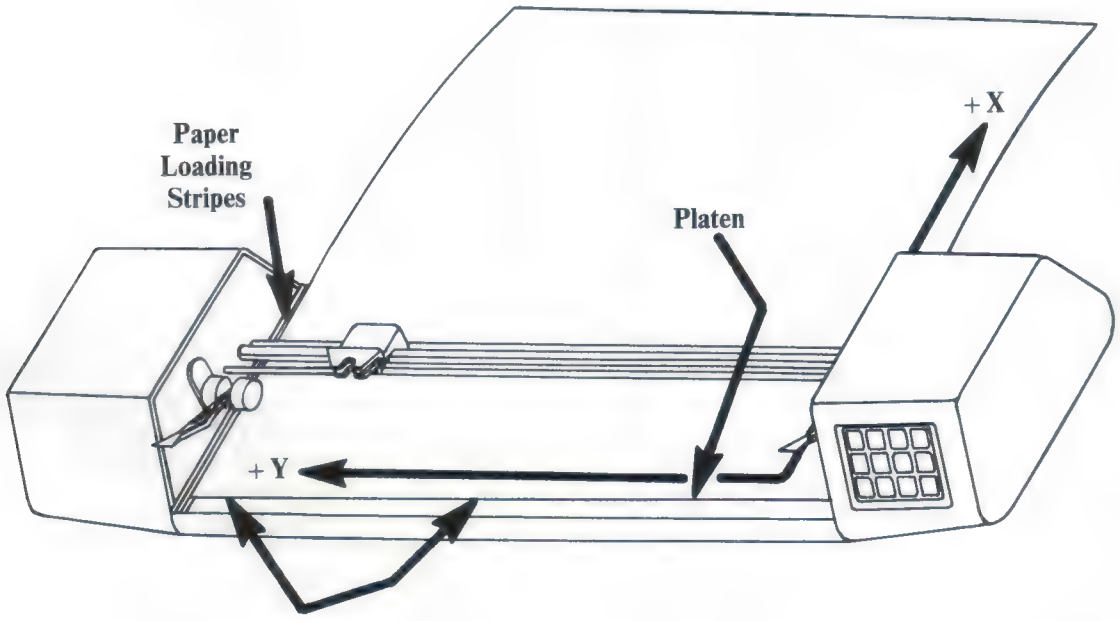
The LARGE and SMALL Control Panel buttons change the Plotter's chart format. This enables you to use small (17 × 22 inches for the DMP-51; 16.5 × 23.4 inches for the DMP-52) or large (22 × 34 inches for the DMP-51; 23.4 × 33.1 inches for the DMP-52) paper to create your plots and graphs. You can also change the chart format in your software when you operate the Plotter from your computer by using the DM/PL Small Chart (EH) and Large Chart (EF) commands. These commands are explained in your DM/PL manual.

NOTE

The Plotter uses vacuum to secure the center area of the paper to the drive shaft. The Plotter's power switch turns the vacuum motor on and off.

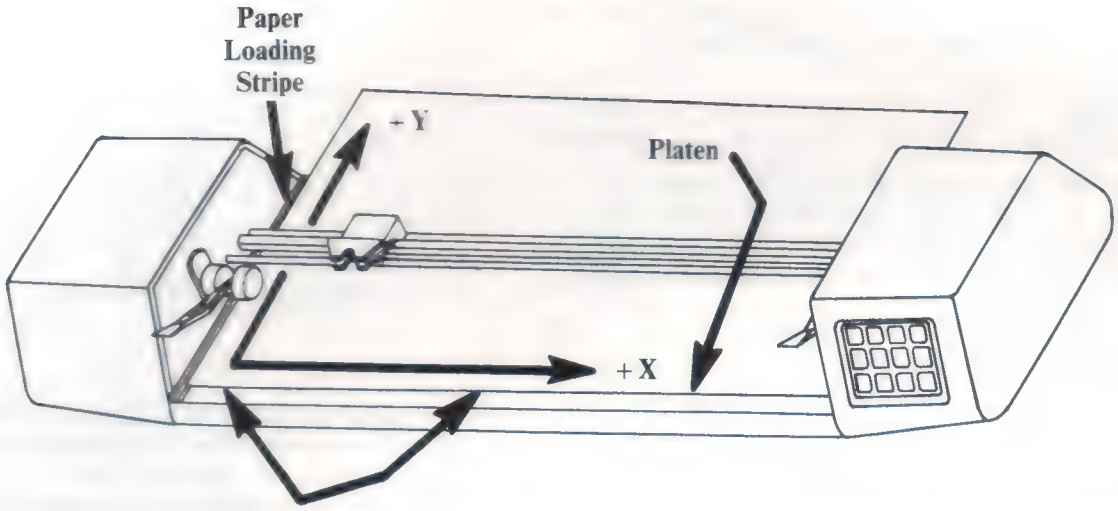
To load large paper, follow the procedure below.

1. Turn the power on. (LARGE chart format is specified at the factory for a Menu power up default value.)
2. Raise each pinch roller arm to disengage the rollers from the paper drive shaft.
3. Insert the paper between the pinch rollers and the paper drive shaft and position it as shown in Figure 1-5.



Align the paper with the front edge of the platen and the appropriate paper loading stripe. For the DMP-51, use the inside strip. For the DMP-52, use the outside stripe.

FIGURE 1-5
LOADING LARGE PAPER



Align the paper with the front edge of the platen and the appropriate paper loading stripe. For the DMP-51, use the inside stripe. For the DMP-52, use the outside stripe.

FIGURE 1-6
LOADING SMALL PAPER

4. After the paper is positioned, lower the pinch rollers to the surface of the paper by gently pushing down on the lever arms.

5. Press LARGE and the Plotter will load the paper.

6. The large paper is now properly loaded.

To load small paper, follow the procedure below.

1. Turn the power on, and then press SMALL. (SMALL chart format can be specified as the power up default value as explained in Section 2.5.)

2. Raise each pinch roller arm to disengage the rollers from the paper drive shaft.

3. Insert the paper between the pinch rollers and the paper drive shaft and position it as shown in Figure 1-6.

4. After the paper is positioned, lower the pinch rollers to the surface of the paper by gently pushing down on the lever arms.

5. Press SMALL and the Plotter will load the paper.

6. The small paper is now properly loaded.

When you change from one paper size to another during your plotting sessions, remember to change the Plotter's chart format as well.

The SMALL and LARGE chart format buttons are also used to manually reset the Plotter. This function is detailed in Section 2.2.

If you have a software program that contains multiple plots and graphs, you can plot each one on a clean sheet of paper without having to stop the program at the computer. The procedure below explains how.

1. Start the program at the computer.

2. After the first plot has completed, press the LOCAL button on the Plotter's Control Panel. (The Plotter will immediately stop processing data. Do not press LARGE or SMALL—this will cause the Plotter to reset.)

3. Remove the paper.

4. Load a clean sheet of paper for the next plot or graph.

5. After the clean paper is loaded, press LOCAL again. The Plotter will resume processing the program without loss of data.

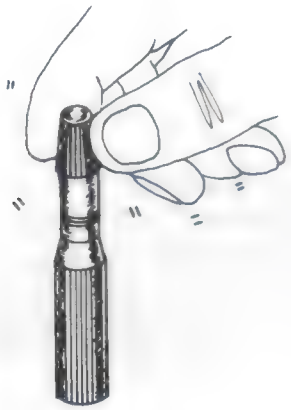
6. Repeat steps 2 through 5 until you have all of the plots and graphs you need from the program.

1.8 PENS

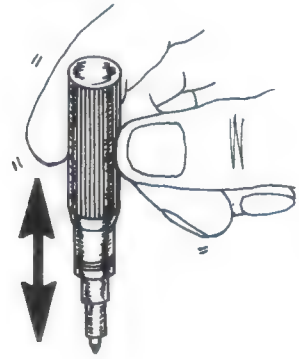
The pens that are supplied with your Plotter are disposable drafting pens specially designed for computer graphics. A variety of pen tip sizes and other plotting accessories are available from your local dealer (see Section 1.2.1).

The following procedure explains how to install a pen in the plotter.

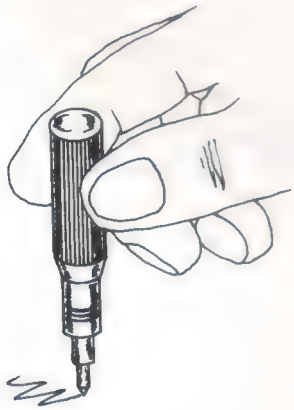
1. Remove the completely assembled disposable technical pen from the storage box. To use the pen for the first time, press downward on the pen cap to push the nib into the body of the ink cartridge to break its seal.



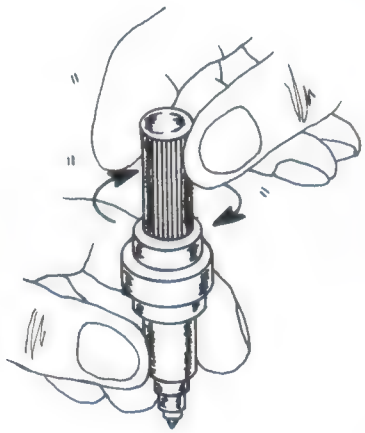
2. Remove and save the pen cap. Briskly shake the pen twice to begin ink flow.



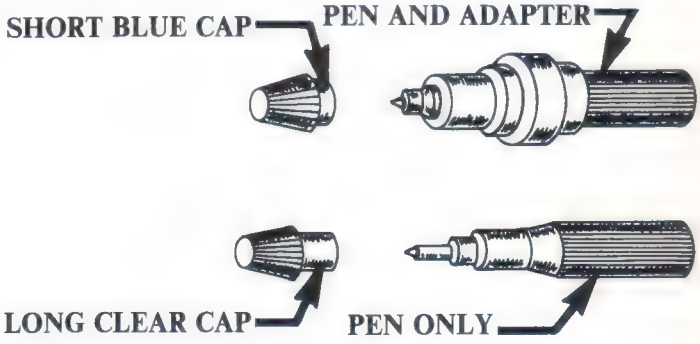
3. Hand draw on scrap paper or vellum to verify its operation.



4. Screw the pen into the adapter until it is hand tight (the pen only fits into the adapter the correct way). Clip the pen assembly into the Plotter's pen holder. Remove the pen assembly from Plotter to change pens. Use with paper or vellum only.



5. When the pen is not in use, cap and store it in the storage box in a horizontal position. Use the short blue pen cap if the pen is in the adapter. Use the long clear pen cap if the pen is not in the adapter.



6 . Remove and save the pen cap. Briskly tap the pen body on a hard surface to restart ink flow.

When the Plotter is not in use, always remove the pen and replace its protective cap.

CAUTION

The wire loop lever located on the rear of the Pen Holder increases the pressure of the pen when it is set to the lower notch position (see Figure 1-7). (Some models may be equipped with a butterfly loop instead of a wire loop lever.) **Be sure the wire loop lever is in the upper notch position if you are using disposable technical pens.** An increase in pressure will cause damage to the technical pen tips and the chart paper. If the Plotter starts producing plots of inferior quality, or the lives of your technical pens are dramatically shortened, inspect the wire loop lever to see if it was accidentally set to the lower notch position. (The lower notch position may be used if ball-point pens are installed in the Plotter.) Use of unapproved supplies will also cause the Plotter to produce poor quality plots.

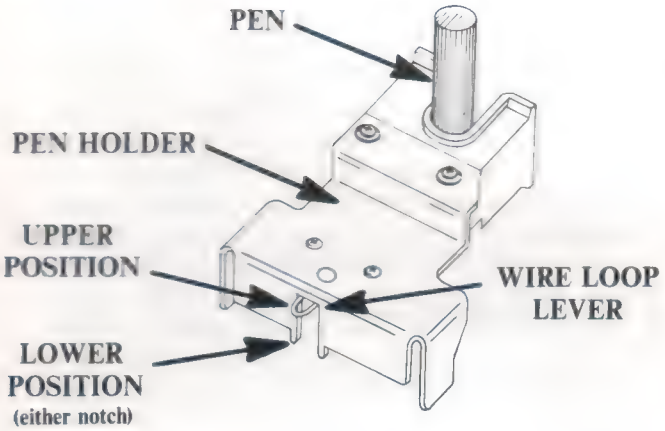


FIGURE 1-7
ADJUSTING THE PEN PRESSURE

1.9 SERIAL RS-232-C INTERFACE

The serial RS-232-C interface enables the Plotter to be connected to and controlled by a RS-232-C compatible host computer/display (CRT) terminal system. The Plotter is equipped with a standard RS-232-C DB-25P connector on its rear panel (see Figure 1-1) and requires a standard RS-232-C DB-25S mating connector.

The Plotter's RS-232-C connector is considered as DTE type equipment, which means *the Plotter always transmits data on Pin 2 and receives data on Pin 3.* Table 1-2 lists the active signals/pins on the Plotter's RS-232-C connector and their direction of travel. Each signal is explained below.

- Transmit Data, Pin 2. The Plotter uses this pin to transmit data to the computer while in Mode Two.
- Receive Data, Pin 3. The Plotter *always* receives data on this pin, regardless of the operating mode.

TABLE 1-2
PLOTTER'S RS-232-C CONNECTOR SIGNALS (DTE)

PIN NUMBER AND SIGNAL NAME	SIGNAL DIRECTION
PIN 1—Chassis ground	Common
PIN 2—Transmit data (TD)	From Plotter
PIN 3—Receive data (RD)	To Plotter
PIN 4—Request To Send (RTS)*	From Plotter
PIN 7—Signal ground	Common
PIN 20—Data Terminal Ready (DTR)*	From Plotter

*PINS 4 and 20 are internally jumpered, and the signal levels can be specified from the Menu to either toggle or remain high.

- Request To Send (RTS), Pin 4, and Data Terminal Ready (DTR), Pin 20. These two pins are internally connected in the Plotter. This signal is used during Mode One handshaking. A high signal level tells the computer that the Plotter is ready for more data (the Plotter's buffer is not full). A low signal level tells the computer to wait until the Plotter can accept more data (the buffer is full). Some computer models require a constant high signal level from these two pins for hardware handshaking. If this requirement applies to your computer, a constant high signal level at Pin 4 (RTS) and Pin 20 (DTR) can be specified from the Plotter's Menu (see Section 2.5).

- Signal Ground, Pin 7. Required signal ground.

The remainder of this section includes instructions on how to fabricate data cables for various types of handshaking and how to connect them to the Plotter and the computer. Read this section thoroughly even if you have purchased our factory prefabricated cables—the information may be useful in the future if you decide to replace your computer system or use the Plotter on another system that has a different handshake sequence. Before attempting to connect the Plotter to your system, consult computer owner's/interface manual and determine what your computer's interface signal requirements are. In general, you will need to know:

- Which RS-232-C I/O port is recommended by your computer's manufacturer for use with other external equipment?

- Is your computer considered as DCE or DTE type equipment?

- What are your computer's handshaking capabilities (hardware, XON/XOFF, software), and what type do you prefer?

- Does your computer/modem require Request To Send (RTS), Clear To Send (CTS), and/or Data Terminal Ready (DTR) signal response?

"Yes, we have no cables..."

If you did not purchase factory prefabricated data cables with your Plotter, you may consider making a cable specifically for the type of handshake used by your computer before trying to set up a communication link using any spare RS-232-C cable that you may have.

Because of the many misinterpretations of the RS-232-C "standards" in the commercial computer industry, a working cable on one system may prove useless on another.

Cable fabrication is inexpensive and requires very little technical skill. Your local dealer or electrical parts house can supply you with the cable wires, end connectors, and the tools you will need to construct a quality cable. When constructing a data cable, always shield each individual signal wire, as well as the entire cable, to prevent internal "cross-talk" and electrical noise from occurring. The mating connector for the Plotter's rear panel connector must be a RS-232-C DB-25S connector. Your computer owner's manual will supply the type of mating connector required for your equipment. The overall length of a data cable should be limited to 15 feet (4.6 meters).

The number of signal wires required in your cable, and to which pins on the end connectors you should connect them to, depend on the type of device that your equipment is considered as (DCE or DTE) and the type of handshaking you prefer to operate with. Figure 1-8 illustrates basic RS-232-C cabling techniques. Specific interface instructions for most of the computer models that are currently on the market are listed in the H.I. Interface Notes supplement (MI-1023), which is supplied with your Plotter.

WARNING

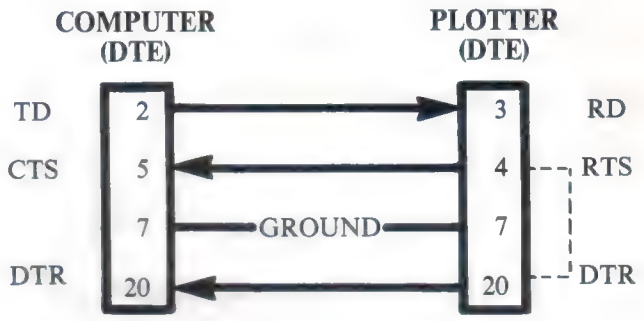
RS-232-C DB-25 connectors use Pin 1 for chassis ground. Although this signal is not required for operation, its function is similar to the earth ground prong on three-contact AC plugs. Regardless of the type of cable you construct, it is highly recommended to always connect Pin 1, chassis ground, at both end connectors.

Hookin' It Up...

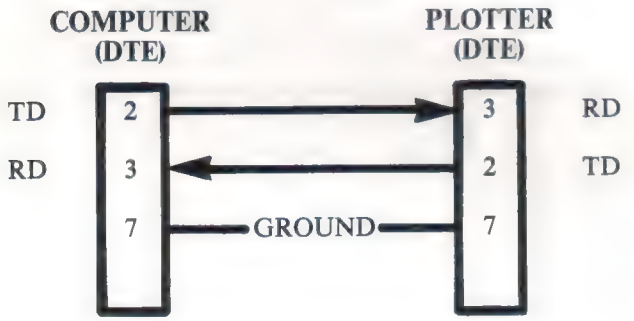
Use the Plotter's Menu mode to set its operating baud rate and parity (see Section 2.5).

Before you connect the Plotter to your computer system with the data cable, check the computer owner's manual for cabling precautions from its manufacturer, and power down the Plotter. Plug one end of the data cable into the computer's RS-232-C I/O port connector, and then plug the other end of the cable into the Plotter's rear panel RS-232-C data connector. The Plotter is now ready to be powered up and operated.

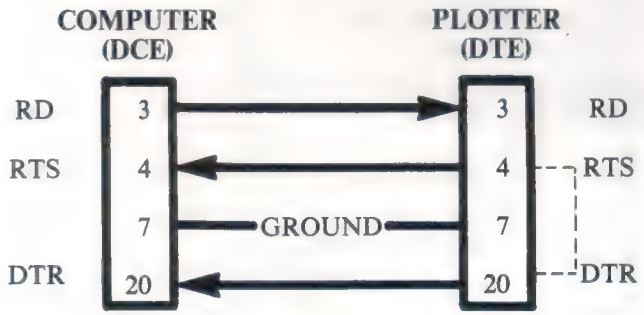
MODE I: HARDWARE HANDSHAKE
(MODEM CONVENTION)



MODE II: XON/XOFF OR
SOFTWARE HANDSHAKE
(MODEM CONVENTION)



MODE I: HARDWARE HANDSHAKE
(TERMINAL CONVENTION)



MODE II: XON/XOFF OR
SOFTWARE HANDSHAKE
(TERMINAL CONVENTION)

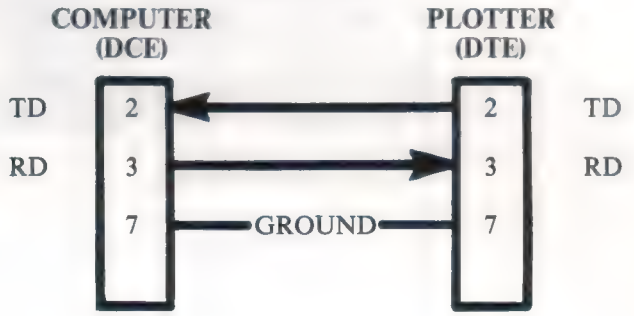


FIGURE 1-8
BASIC RS-232-C CABLING TECHNIQUES

NOTES:

1. THESE DIAGRAMS SHOW THE MOST COMMON CONNECTIONS ONLY. YOUR COMPUTER MAY REQUIRE ADDITIONAL CONNECTIONS (SEE SUPPLEMENT MI-1023).

2. PLOTTER PINS 4 AND 20 ARE INTERNALLY JUMPERED, AND A CONSTANT HIGH SIGNAL LEVEL AT BOTH PINS CAN BE SPECIFIED FROM THE PLOTTER'S MENU.

3. THE PLOTTER IS ALWAYS A DTE DEVICE.

1.9.1 (RS-232-C) Pass-Through Port Feature

The Pass-Through Port feature enables you to transmit the data received by the Plotter from the host computer to an auxiliary CRT device.

To connect an auxiliary CRT device to the host computer/Plotter configuration, three additional signal wires must be connected from the Plotter's rear RS-232-C connector to the CRT. These signal connections are shown in Table 1-3.

After the signal connections are made, the type of control you want for the Pass-Through Port data from the Plotter (Pin 16) to the CRT (Pin 3) can be specified from the Plotter's Menu (always on or toggle).

Instructions on how to make selections from the Plotter's Menu are listed in Section 2.5.1.

The Pass-Through Port can also be activated from the computer by using the DM/PL X command, which is explained in your DM/PL manual.

CAUTION

Use only Pins 14, 16, and 7 to connect an auxiliary device to the Plotter. If an auxiliary device is connected to the Plotter and XON/XOFF (Mode One) handshaking is used, make certain that the device connected to the Plotter's Pass-Through Port does not transmit an XON/XOFF handshake while the Plotter is operating. This may cause the host computer to respond to the wrong handshake signal and transmit erroneous plot codes.

TABLE 1-3
RS-232-C PASS-THROUGH PORT SIGNAL CONNECTIONS

COMPUTER SIGNAL PIN (DCE)	PLOTTER SIGNAL PIN (DTE)	AUXILIARY (CRT) SIGNAL PIN (DTE)
PIN 2 (RD)	TO PIN 2 (TD)	
PIN 3 (TD)	TO PIN 3 (RD)	
PIN 7 (GRND)	TO PIN 7 (GRND)	TO PIN 7 (GRND)
	PIN 14 (ARD)	TO PIN 2 (ATD)
	PIN 16 (ATD)	TO PIN 3 (ARD)

RD = Receive data
TD = Transmit data
GRND = Common Signal Ground
ARD = Auxiliary Receive Data
ATD = Auxiliary Transmit Data

An illustration of this type of connection is shown in Figure 1-9.

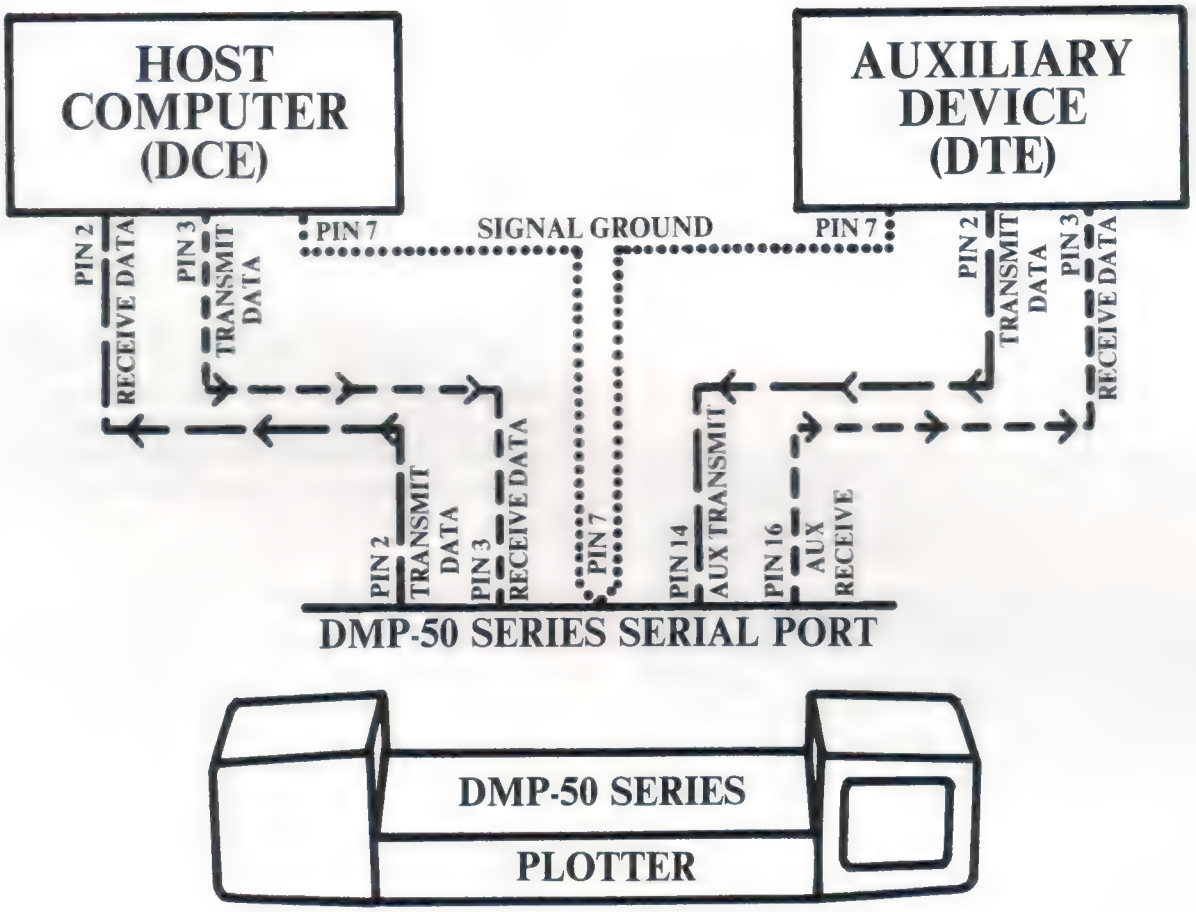


FIGURE 1-9
HOST/PLOTTER/CRT CONFIGURATION

1.10 DIGITIZE MODE

Digitize mode enables the Plotter to transmit the x,y coordinate point of the current position of the pen to the computer for processing. Digitize mode must be activated from the computer with the DM/PL Digitize command (see your DM/PL manual).

Your computer must be programmed to receive the x,y point data, which is ASCII BCD format, from the Plotter. (Consult your computer's software manual for programming instructions.) The data from the Plotter consists of two, six-digit, signed* coordinates in parenthesis, followed by a carriage return <CR> terminator.

Example of digitized x,y point data:

(001200, 000850) <CR>

After the Plotter receives an ED command, it switches to LOCAL mode (STATE 1), and the ENTER indicator blinks on and off. You can now use the ↑, ↓, →, and ← buttons to move the pen to the location of the point you want digitized. After you position the pen, press ENTER, and the Plotter will transmit the x,y coordinates of the pen's position to the computer, the ENTER indicator will turn off, and the Plotter will return to STATE 0. (After STATE 0 is entered, the pen will move to the location it was at prior to the ED command.) Repeat this procedure for each point to be digitized.

The following is a sample program which demonstrates the use of the digitizing function of the Plotter. The program in this example is for an Apple II Plus ™ host computer using AppleSoft™ Basic DOS 3.3 operating system.

```
10 D$ = CHR$ (4)
15 X = n
20 PRINT D$;"PR#";X
30 PRINT D$; "IN#";X
40 PRINT";:H"
50 FOR I = 1 TO 10
55 PRINT "ED"
60 INPUT X$,Y$
70 X=VAL(RIGHT$ (X$,6)):Y=VAL(LEFT$ (Y$,6))
80 PRINT D$;"PR#0"
90 PRINT X,Y
100 PRINT D$;"PR#";X
110 NEXT I
120 PRINT "Z"
130 END
```

Line 10—D$ toggles from BASIC to DOS operating system.

Line 15—*n* is the slot number of the serial interface card. For example, X = 1 indicates serial card in slot #1.

Line 20—opens serial port for output.

Line 30—opens serial port for input.

Line 40—initializes (selects) the Plotter.

Line 50—FOR Loop that allows ten points to be digitized.

Line 55—starts digitizing mode on the Plotter.

Line 60—inputs X and Y coordinates from the Plotter.

Line 70—decodes X and Y coordinates.

Line 80/90—prints X and Y coordinates to screen.

Line 100—opens serial port for output.

Line 110—NEXT statement for FOR Loop in Line 50.

Line 120—software resets the Plotter at end of buffer.

*A positive value must be signed with a "space," and a negative value must be signed with a "—".

SECTION 2
OPERATION

2.1 THE CONTROL PANEL

The Plotter's Control Panel consists of 12 membrane (switch) buttons and four LED indicators. The buttons are arranged in three rows with each row consisting of four buttons (see Figure 2-1).

The LARGE and SMALL buttons in Row One are used to change the chart format and to manually reset the Plotter. The other two buttons in Row One are used to place the Plotter in one of its four operating modes—STATE 0, STATE 1, STATE 2, or STATE 3. The current operating mode of the Plotter determines the functions of the buttons in Row Two and Row Three. The four operating modes and the functions of the remaining buttons are explained in the following sections.

Each button in Row One has a LED indicator that will illuminate when its function is activated. When its function is deactivated, the LED indicator will turn off. (The LEDs also display error codes if the Plotter detects a logic failure during reset or Self-Test. These codes are explained in Appendix B.)

NOTE

Illustrations similar to Figure 2-1 are referred to throughout this section. In these drawings, the symbol "●" specifies an activated (on) LED indicator and the symbol "○" specifies a deactivated (off) LED.

2.2 CHART FORMAT/MANUAL RESET

As stated in Section 1.7, one of the functions of the LARGE and SMALL buttons is to change the chart format of the Plotter. If large paper is to be used, the LARGE button must be pressed; if small paper is to be used, the SMALL button must be pressed.

The other function of these buttons is to reset the Plotter. If either button is pressed, the pen will move to home position, the paper will shuffle, and a reset will occur. A reset causes the default values listed in Table 2-1 to become current.

2.3 STATE 0 MODE

The Plotter automatically enters STATE 0 when the chart paper format is changed or the Plotter is manually reset (see Section 2.2). The indicators on the LOCAL and ENTER buttons are turned off when the Plotter is operating in STATE 0.

2.3.1 Remote Operation

STATE 0 enables you to control all plotting activity with the software commands in the DM/PL protocol (see your DM/PL manual). A DM/PL Mode One or Mode Two Plotter Select command establishes the communication link between the two devices. After the Plotter is selected, it continues to operate under computer control until it is either deselected, reset, or powered down.

The functions of the buttons in Row Two and Row Three of the Control Panel are disabled when the Plotter is operating in STATE 0.

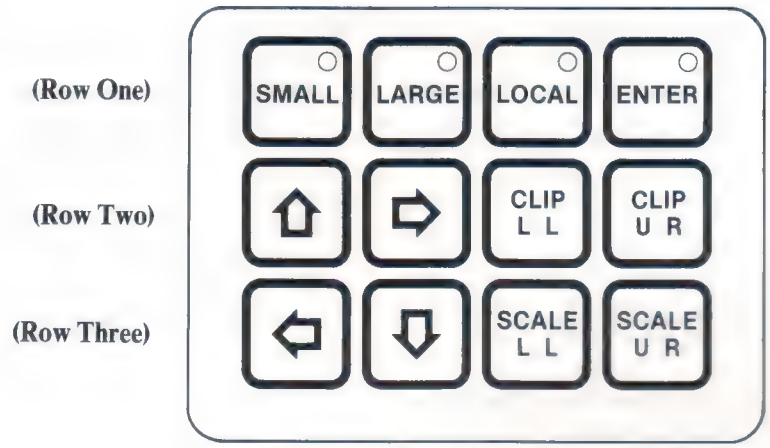


FIGURE 2-1
THE CONTROL PANEL

TABLE 2-1
EFFECTS OF A RESET

Plotter deselected	
State 0 active	
Maximum Window limits	
Maximum Scale Box limits	
Horizonal text path	
Character size 8	
Italics off (text)	
Character set	Menu value
Baud rate	Menu value
Handshake RTS/DTR	Menu value
UART parity	Menu value
Addressing resolution	Menu value
Chart size	Menu value
Pen Pause	Menu value
Pen Up velocity	Menu value
Pen Down velocity	Menu value
Pen acceleration	Menu value
Pen Down acceleration	Menu value
Pen Down Delay	Menu value
Pen Up Delay	Menu value
Pass-Thru port option	Menu value

2.4 STATE 1 MODE

STATE 1 mode enables you to control the Plotter using the Control Panel buttons. STATE 1 is initiated by first placing the Plotter in STATE 0 (LOCAL and ENTER indicators off) and then pressing LOCAL. (The LOCAL indicator will illuminate.) To exit the Plotter from STATE 1 and return it to STATE 0 (remote control), press LOCAL. (The LOCAL indicator will turn off.)

2.4.1 Local Operation

When the Plotter is placed in STATE 1, which enables local operation, plotting activity can be manually controlled from the Control Panel buttons. Manual operation of the Plotter is explained below.

When this button is pressed and held, the paper is driven toward the rear of the Plotter. To stop the paper drive, release the button.

When this button is pressed and held, the paper is driven toward the front of the Plotter. To stop the paper drive, release the button.

When this button is pressed and held, the pen is driven across the beam to the right. The pen will stop at the end of the beam or when the button is released.

When this button is pressed and held, the pen is driven across the beam to the left. The pen will stop at the end of the beam or when the button is released.

The pen moves the current lower left corner of the Window when this button is pressed and released (see Section 2.6.1).

When this button is pressed and released, the pen moves to the current upper right corner of the Window.

The pen moves to the current lower left corner of the Scale Box if this button is pressed and released (see Section 2.6.1).

When this button is pressed and released, the pen moves to the current upper right corner of the Scale Box.

The pen's up/down status changes if the LOCAL button is pressed and held, and then the ENTER button is pressed.

When these two buttons are pressed simultaneously, the Plotter performs the Self-Test routine (see Section 2.4.2).

To exit STATE 1 and return to STATE 0, press LOCAL.

2.4.2 Self-Test

The Self-Test routine is an off-line (local) performance check of the Plotter's logic circuitry and mechanics. The Self-Test program is stored in the Plotter's Read-Only-Memory (ROM) and can be initiated manually or from your computer. The Self-Test program instructs the Plotter to simulate an actual remote plotting session and checks for logic and mechanical malfunctions during its execution. The Plotter's mechanical performance is tested first with the Self-Test plot design. This plot design consists of different alphanumeric characters and symbols (see Figure 2-2). The Plotter's operating configuration, such as baud rate and resolution settings, ROM REVision numbers, etc., are also included in the plot. After the plot, the Plotter's logic circuitry (ROM, RAM, buffer, etc.) is tested. If a failure occurs during this portion of the test, an error code is displayed by the Control Panel LEDs (see Appendix B).

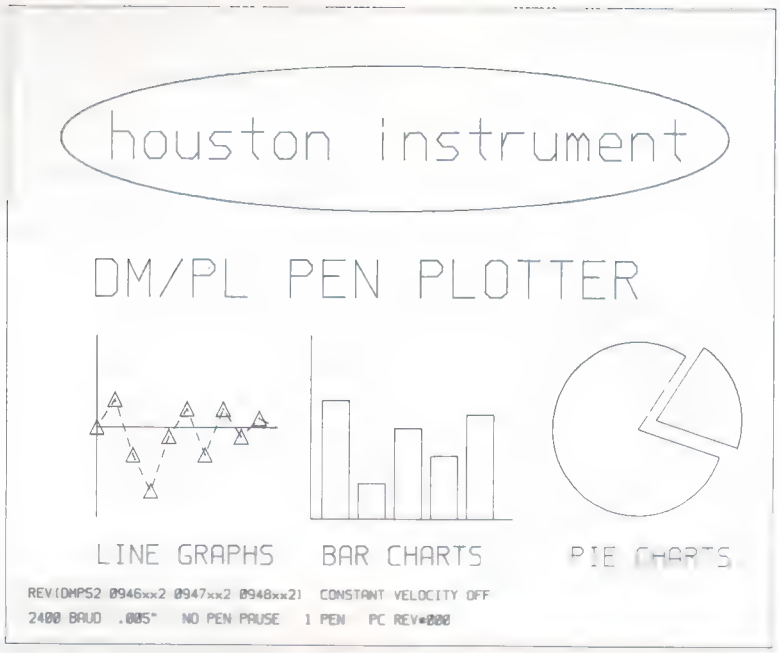


FIGURE 2-2
THE SELF-TEST PLOT DESIGN

The procedure for initiating Self-Test from the Control Panel is explained in Section 2.4.1. The procedure for initiating Self-Test from your computer is explained in your DM/PL manual.

NOTE

The Self-Test routine resets the Plotter to the default operating level. The default values are listed in Section 2.2.

The following paragraphs describe the areas of interest of the test plot.

- ROM AND MODEL IDENTIFICATION (REV). This line identifies the plotter model (DMP52) and provides information concerning the ROMs installed (U22, U23, and U8). The ROMs are identified by three, seven-digit codes (U22) 0946ØØ2, (U23) 0947ØØ2, and (U8) 0948ØØ2. The first four digits are the ROM part number. The last three digits are the ROM revision level. For example, 0946ØØ2 indicates that ROM U22 is part number MW-946 at revision ØØ2.

NOTE

The part numbers and/or revision levels of the ROMs used in your Plotter may differ from those shown in the example.

- CONSTANT VELOCITY OFF indicates that the constant velocity feature is currently deactivated (see Sections 2.5.1 and 2.5.2).
- 2400 BAUD indicates that the current baud rate is selected for 2400 (see Section 2.5.1).
- .005'' indicates that the current resolution is selected for .005'' (see Section 2.5.1).
- NO PEN PAUSE indicates that the pen pause feature is currently deactivated (see Section 2.5.1).
- 1 PEN describes the type of pen holder used on your Plotter.
- PC REV=000 provides the revision number of your Plotter's printed circuit board.

NOTE

The revision level of the board used in your Plotter may differ from the revision level shown in the example.

- The remainder of the test plot must be exactly as shown.

2.5 STATE 2 MODE

The Plotter must be entered into STATE 2 mode from STATE 0. To activate STATE 2 mode, first place the Plotter in STATE 0, and then press ENTER. (The ENTER indicator will illuminate.)

After the Plotter is placed in STATE 2, the buttons in Row Two and Row Three of the Control Panel can be used to change the Plotter's Menu settings and to make temporary changes to the Plotter's velocity and Pen Change status during STATE 0 plotting activities.

2.5.1 Menu Mode

The Menu mode enables you to personalize the power-up operating configuration of your Plotter. For example, you can have your Plotter ready to operate at 9600 baud, .1 mm resolution, even parity, large chart format, and German character set active every time you turn the power switch on. This section first explains how to use the Control Panel to enter Menu mode, and then describes each of the 14 Menu parameters and how to make a selection.

Before starting the procedure, turn the Plotter's power on (see Section 1.6), load large paper (see Section 1.7), and install a pen (see Section 1.8). (If the Plotter is already on, place it in STATE 0 by pressing LARGE.)

In general, Menu mode works like this:

- Menu mode must be entered and exited with the same Control Panel button—SCALE UR.
- After it plots the parameter, the pen stops over the number or word that indicates the current setting. To specify a new setting, use the ← or → button to move the pen over the new selection. After the pen is positioned, press ENTER to register the new setting. If a new setting is not desired, simply press ENTER. In either case, the Plotter will draw a line under the setting before proceeding to the next parameter after ENTER is pressed, thus providing you with a hardcopy of the current Menu settings.
- Menu mode can be exited at any time by pressing SCALE UR. (The Plotter initializes the Menu default values when the mode is exited.)

Follow the procedure below to initiate Menu mode and make selections. (The following set of instructions includes the factory-selected Menu settings in parenthesis.)

1. Place the Plotter from STATE 0 to STATE 2 by pressing the ENTER button.

2. Next, initiate Menu mode by pressing SCALE UR. The Plotter will print the first Menu parameter, which is the velocity of the pen in the pen down position, and then park the pen over the current setting (16 ips). If you do not want to change this setting, press ENTER, and the pen will underline 16 and proceed to the next parameter. If you do want to change this setting, use the ← and → buttons to move the pen over a new velocity. After the pen is positioned, press ENTER, and the pen will underline the new selection and proceed to the next parameter.

   PEN DOWN VELOCITY (ips):
   2 3 4 5 6 7 8 9 1Ø 11 12 13 14 15 16

3. The next Menu parameter is the pen velocity in the pen up position. After the Plotter prints the parameter, it will park the pen over the current setting (16 ips). If this is the desired setting, press ENTER, and the Plotter will proceed to the next parameter. To select a new pen up velocity, use the ← and → buttons to move the pen over a new setting, and then press ENTER. After ENTER is pressed, the Plotter will proceed to the next Menu parameter.

   PEN UP VELOCITY (ips):
   2 3 4 5 6 7 8 9 1Ø 11 12 13 14 15 16

4. The next Menu parameter is the rate of acceleration for the pen in the pen down position (2G). If this is the desired setting, press ENTER, and the Plotter will proceed to the next parameter. To change the parameter, use the ← and → to move the pen over a new setting, and then press ENTER. After ENTER is pressed, the Plotter will proceed to the next parameter.

   PEN DOWN ACCELERATION:
   Ø.5G 1G 2G 3G 4G

5. The next Menu parameter is the rate of acceleration for the pen in the pen up position (4G). If this is the desired setting, press ENTER, and the Plotter will proceed to the next parameter. To change the parameter, use the ← and → buttons to move the pen over a new setting, and then press ENTER. After ENTER is pressed, the Plotter will proceed to the next parameter.

PEN UP ACCELERATION:
Ø.5G 1G 2G 3G 4G

6. The next Menu parameter is the time in milliseconds that you want the pen to delay before moving to its down position (40ms). Press ENTER if this is the desired setting, or select a different delay time by using the ← and → buttons to move the pen over a new setting and then pressing ENTER. After ENTER is pressed, the Plotter will move to the next parameter.

PEN DOWN DELAY (ms):
Ø 5 1Ø 15 2Ø 25 3Ø 35 4Ø 45 5Ø 55 6Ø 65 7Ø

7. The next Menu parameter is the time in milliseconds that you want the pen to delay before moving to its up position (20ms). Press ENTER if this is the desired setting, or select a different delay time by using the ← and → buttons to move the pen over a new setting and then pressing ENTER. After ENTER is pressed, the Plotter will move to the next parameter.

PEN UP DELAY (ms):
Ø 5Ø 15 2Ø 25 3Ø 35 4Ø 45 5Ø 55 6Ø 65 7Ø

8. The Plotter's chart format select is the next Menu parameter (large). If large format is the desired chart size, press ENTER, and the Plotter will proceed to the next parameter. If you would rather small chart at power-up, use the ← and → buttons to move the pen over "Small," and then press ENTER.

PAPER SIZE:
Small Large

On DMP-52 models, the Menu includes an additional chart size parameter to accommodate metric and English chart sizes. (There are two small chart sizes and two large chart sizes.) Use this parameter to select the size that you prefer for small and large chart formats.

SMALL CHART FORMAT:
18" × 24" A2 (METRIC)

LARGE CHART FORMAT
24" × 36" A1 (METRIC)

9. The next Menu parameter activates the Plotter's Pen Pause feature (Ignore). The Pen Pause feature enables you to create multi-colored plots and graphs with your DM/PL software programs. When this function is activated by selecting "Pause," the Plotter scans your software programs for DM/PL New Pen (P) commands (see your DM/PL manual). If a New Pen (P) command is received, the Plotter switches to STATE 1 (local) and stops. After changing the pen to the color you want, press LOCAL and the Plotter will resume processing the program without loss of data.

To activate the Pen Pause feature, use the ← and → buttons to move the pen over "Pause," and then press ENTER. To deactivate the feature, move the pen over "Ignore," and then press ENTER. (When the Pen Pause feature is not activated, the Plotter ignores all New Pen (P) commands that are transmitted from the computer.) After ENTER is pressed, the Plotter will proceed to the next parameter.

PEN CHANGE ACTION:
Ignore Pause

10. The constant velocity option is the next selection on the Menu (ON). If the option is deactivated, the Plotter operates at its Menu-selected velocity only on x or y axis movements, but tangential movements are made at a higher velocity. (Tangential moves increase the velocity of the pen as it travels over the paper because the paper is moving as well.) For example, if 16 ips is selected on the Menu for pen down velocity with the option deactivated, the Plotter moves at 16 ips on x or y movements; however, it moves 22 ips on x,y movements. If the option is turned on, the Plotter operates at the specified velocity regardless of the angle of movement (that is, 16 ips for x and y and x,y). Press ENTER to continue the Menu, or use the ← and → buttons to move the pen over a different selection, and then press ENTER.

CONSTANT VELOCITY OPTION:
ON OFF

11. The next Menu parameter determines the Plotter's resolution at power-up (.001 in). If .001" is not desired, use the ← and → buttons to move the pen over a different setting, and then press ENTER. After ENTER is pressed, the Plotter will plot the next parameter.

ADDRESSING:
.ØØ1 in. .ØØ5 in. .1 mm .Ø25mm

12. This parameter selects which character set will be active at power-up (GØ). (The eight different character sets are illustrated in the Extended Text command section in your DM/PL manual.) To select a character set, use the ← and → buttons to move the pen over a different set, and then press ENTER. After ENTER is pressed, the Plotter will proceed to the next parameter.

    CHARACTER SET:
    GØ G1 G2 G3 G4 G5 G6 G7

13. The next parameter selects the font style that the Plotter will use when it receives DM/PL Text commands (FØ). "FØ" specifies sans serif and "F1" specifies Roman Bold. Use the ← and → buttons to change the selection or press ENTER to continue the Menu.

    TEXT FONT:
    FØ F1

14. This parameter selects the Plotter's operating baud rate at power-up (2400). If 2400 baud is not desirable, use the ← and → buttons to move the pen over a different baud rate, and then press ENTER. After ENTER is pressed, the Plotter will plot the next parameter.

    BAUD RATE:
    96ØØ 48ØØ 24ØØ 12ØØ 6ØØ 3ØØ

15. This parameter selects the byte format and parity type used (BIT 8=0). "BIT 8=1" specifies no parity, eight data bits, with bit number eight equal to a one. "BIT 8=0" specifies no parity, eight data bits, with bit eight equal to a zero. "EVEN" specifies seven data bits with even parity as the eighth bit, and "ODD" specifies seven data bits with odd parity as the eighth bit. To select a format, use the ← and → buttons to move the pen over the selection, and then press ENTER. After ENTER is pressed, the Plotter will proceed to the next parameter.

    UART PARITY:
    BIT 8 = 1 BIT 8 = Ø EVEN ODD

16. This parameter can be used to control the Plotter's RS-232-C connector pins 4 (RTS) and 20 (DTR) (TOGGLE). (The Plotter's RS-232-C interface requirements are explained in Section 1.9.) If your computer requires a constant high signal level at these two pins, use the ← and → buttons to move the pen over "ALWAYS HIGH," and then press ENTER. If your computer uses these two pins for handshaking, move the pen over "TOGGLE," and then press ENTER. The Plotter will proceed to the last Menu parameter after ENTER is pressed.

    HANDSHAKE RTS/DTR:
    TOGGLE ALWAYS HIGH

17. This parameter enables you to control the Plotter's Pass-Through Port option with your software. (The Pass-Through Port feature is discussed in Section 1.9.1.) If "TOGGLE" is specified, the Pass-Through Port is disabled when the Plotter is selected, but can be activated by sending the Plotter the DM/PL Pass-Through Port Enable (X) command (see your DM/PL manual). If "ALWAYS ON" is specified, the Pass-Through Port is activated when the Plotter is powered on and will remain active until the Plotter is powered down.

    PASS-THRU PORT OPTION:
    TOGGLE ALWAYS ON

18. Exit Menu mode by pressing SCALE UR. This causes the Plotter to initialize the Menu values.

2.5.2 Temporary Velocity Settings

STATE 2 enables you to toggle the constant velocity option and to make temporary changes to the pen down velocity during plotting activities without having to access the Menu. If the Plotter is placed in STATE 2 from STATE 0 by pressing ENTER, pen down velocities of 8, 10, 12, 14, or 16 ips can be specified by pressing ↑, →, CLIP LL, CLIP UR, or ←, respectively. The constant velocity option can be toggled on and off in this mode by pressing SCALE LL (see Figure 2-3). To resume plotting at the specified Menu values, press ↓.

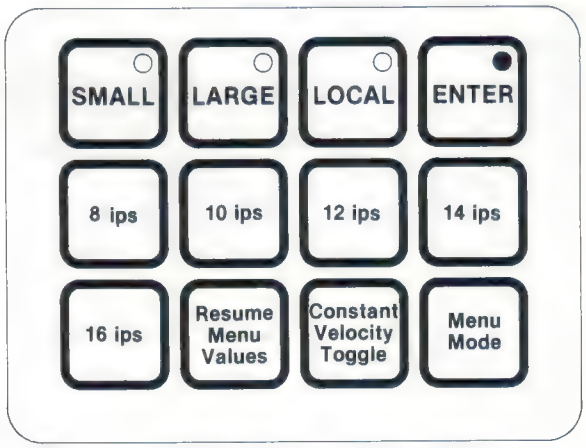


FIGURE 2-3
TEMPORARY STATE 2 CONTROL ENTRIES

A temporary STATE 2 Control Panel entry remains in effect until the Plotter is powered down, or until the Menu is accessed, or the Plotter is returned to STATE 2 and the ↓ button is pressed. (A reset will not cause a temporary setting to default to a Menu value.) DM/PL Velocity commands are ignored if a velocity is selected

at the Control Panel. This enables you to override your programmed velocities.

The following procedure explains how to specify a temporary velocity setting on a Plotter operating in STATE 0 with a Menu velocity or DM/PL V command velocity of, for example, 16 ips.

1. During a plot program, you decide to try a complex plot design at a slower rate of velocity of 8 ips.

2. Just before the Plotter processes the portion of the program which contains the design, press ENTER for STATE 2. (The ENTER indicator will illuminate and the Plotter will stop processing data after ENTER is pressed.)

3. Press ↑ for 8 ips (see Figure 2-3). After ↑ is pressed, the Plotter automatically returns to STATE 0 and continues processing.

4. After the Plotter draws the design at 8 ips, press ENTER for STATE 2. Plotting can be resumed at Menu velocity (16 ips) by pressing ↓ (see Figure2-3).

2.6 STATE 3 MODE

STATE 3 enables you to specify different Window (Clip) and Scale Box limits. To place the Plotter in this mode, you must first specify STATE 1 (press and release LOCAL) and then specify STATE 3 by pressing and releasing ENTER. (The LOCAL and ENTER indicators will illuminate.)

The Plotter automatically returns to STATE 1 when a new limit is specified. If an error is made when specifying a limit, the Plotter will return to STATE 1 and the LED indicator on ENTER will blink on and off. If this condition occurs, press ENTER and specify the limits again.

After the limits have been set, return the Plotter to STATE 0 by pressing LOCAL. (The LOCAL and ENTER indicators are both off when the Plotter is in STATE 0.)

2.6.1 Window, Scale Box, and Viewport Functions

As you become more familiar with your Plotter, and the complexity of your plots increases, you will discover many useful applications for the Plotter's Window and Scaling capabilities. These functions enable you to select any subpart of a plot design, change its size and/or height-to-length (aspect) ratio, and then plot it separately on a different sheet of chart paper. This section first provides a functional overview of the Window, Scale Box, and Viewport features, and then explains how to use them.

The Window...

The subpart of a plot design that is selected to be re-plotted is called a *Window plot*. A Window plot is created by specifying an imaginary rectangle around a subpart using two points, called the *lower left (LL) and the upper right (UR) Window corner points* (see Figure 2-4). The lines of the imaginary rectangle are called *Window limits*. Only the plot data within the specified Window limits will be processed by the Plotter when the design's program is rerun, thus, only the subpart (Window plot) will be plotted on the paper.

The Scale Box...

If a subpart of a plot design is selected as a Window plot and then the program is rerun, the subpart will be plotted at the same size as it appeared in the full plot design. However, if you want the subpart plotted at a larger or smaller size, or with a different height-to-width ratio (aspect) for a special visual effect, you can specify these changes with the *Scale Box* function before rerunning the program. Like the Window, the Scale Box is an imaginary rectangle which must be specified by two points, called the *lower left (LL) and the upper right (UR) Scale Box corner points*. The lines of the imaginary rectangle are called *Scale Box limits*. If a Scale Box rectangle is specified after a Window rectangle is placed around a subpart, the Plotter will process the plot data defined in the Window *at the size specified by the Scale Box rectangle*. For example, if a Scale Box rectangle is specified the same length as the Figure 2-4 Window, but three times the height, the subpart plot will appear "squeezed" when the program is rerun (see Figure 2-5a). If a Scale Box rectangle is specified the same height as the Window, but three times the length, the subpart plot will appear "stretched" (see Figure 2-5b). If the Scale Box rectangle is specified three times the height and length of the Window rectangle, the subpart plot will appear three times as large (see Figure 2-5c).

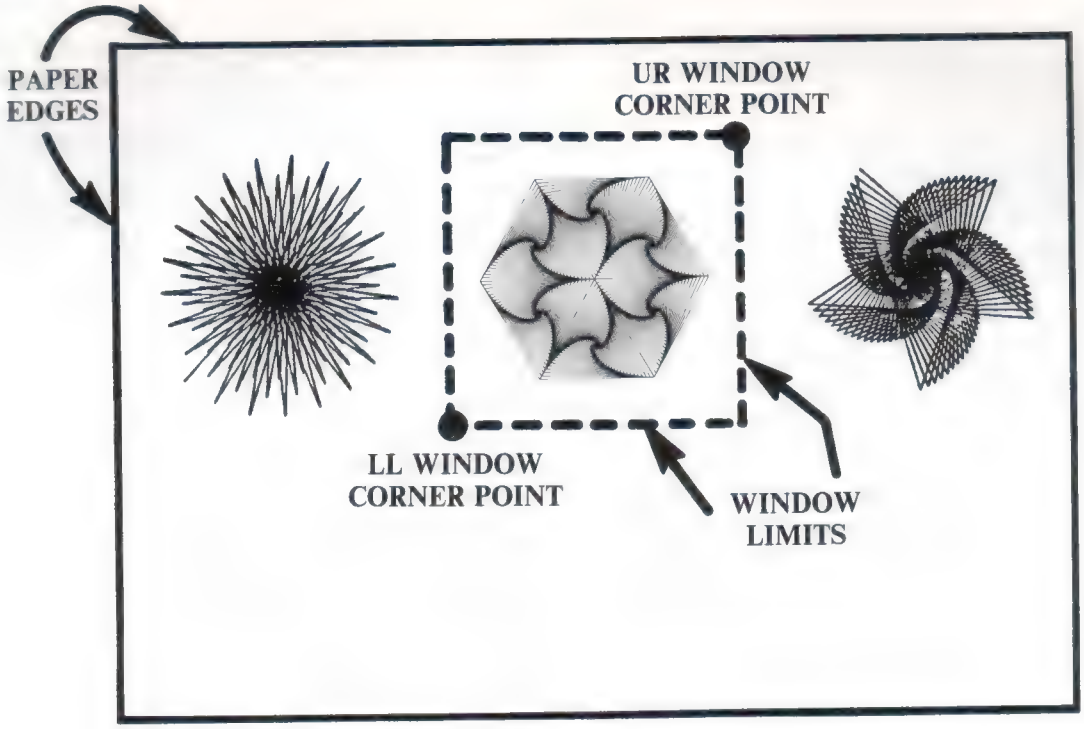


FIGURE 2-4
WINDOW LIMITS AROUND A SUBPART OF A PLOT DESIGN

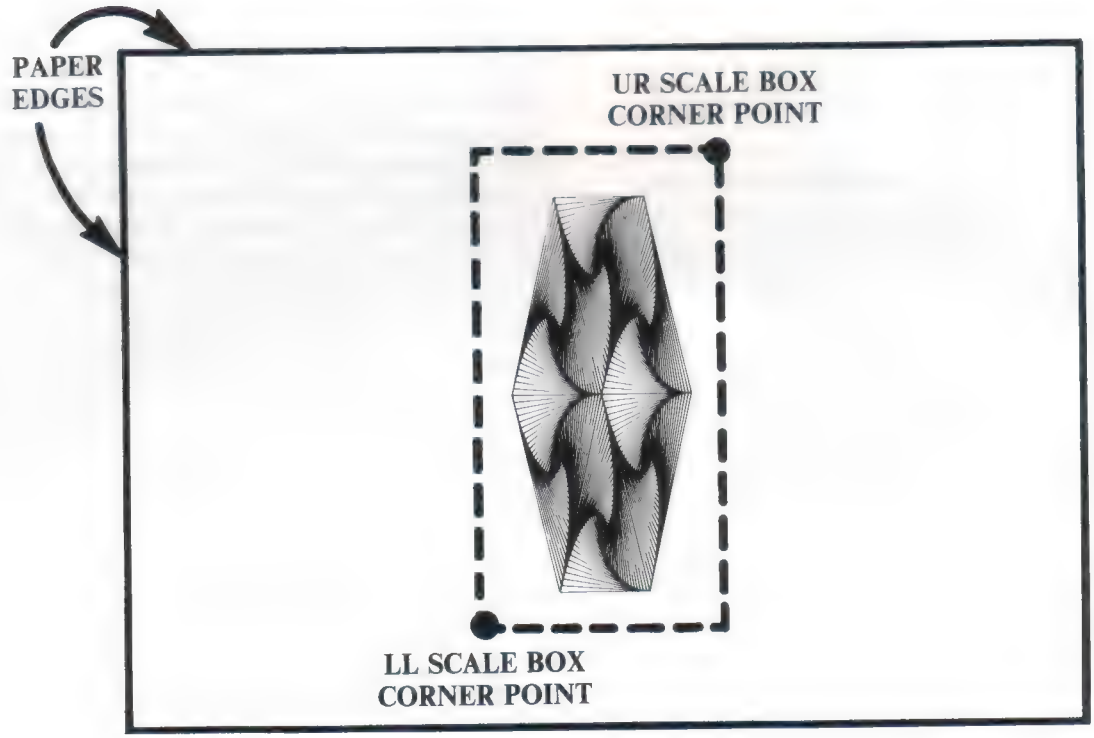


FIGURE 2-5a
A SCALE BOX THREE TIMES THE HEIGHT OF THE WINDOW

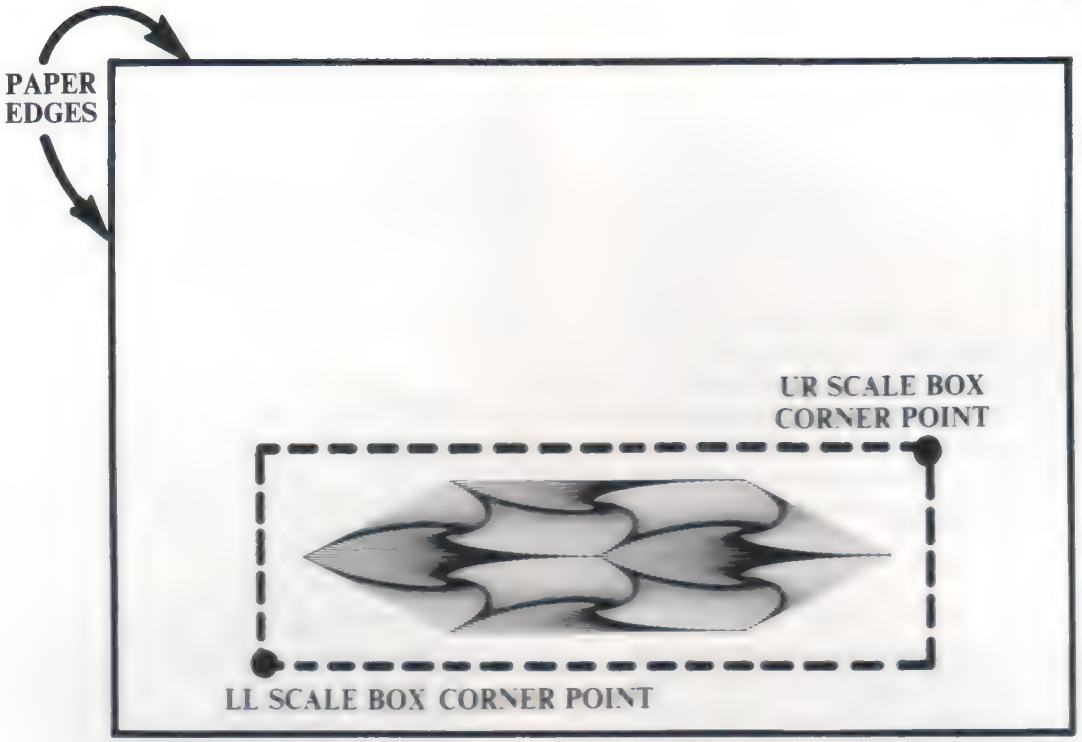


FIGURE 2-5b
A SCALE BOX THREE TIMES THE LENGTH OF THE WINDOW

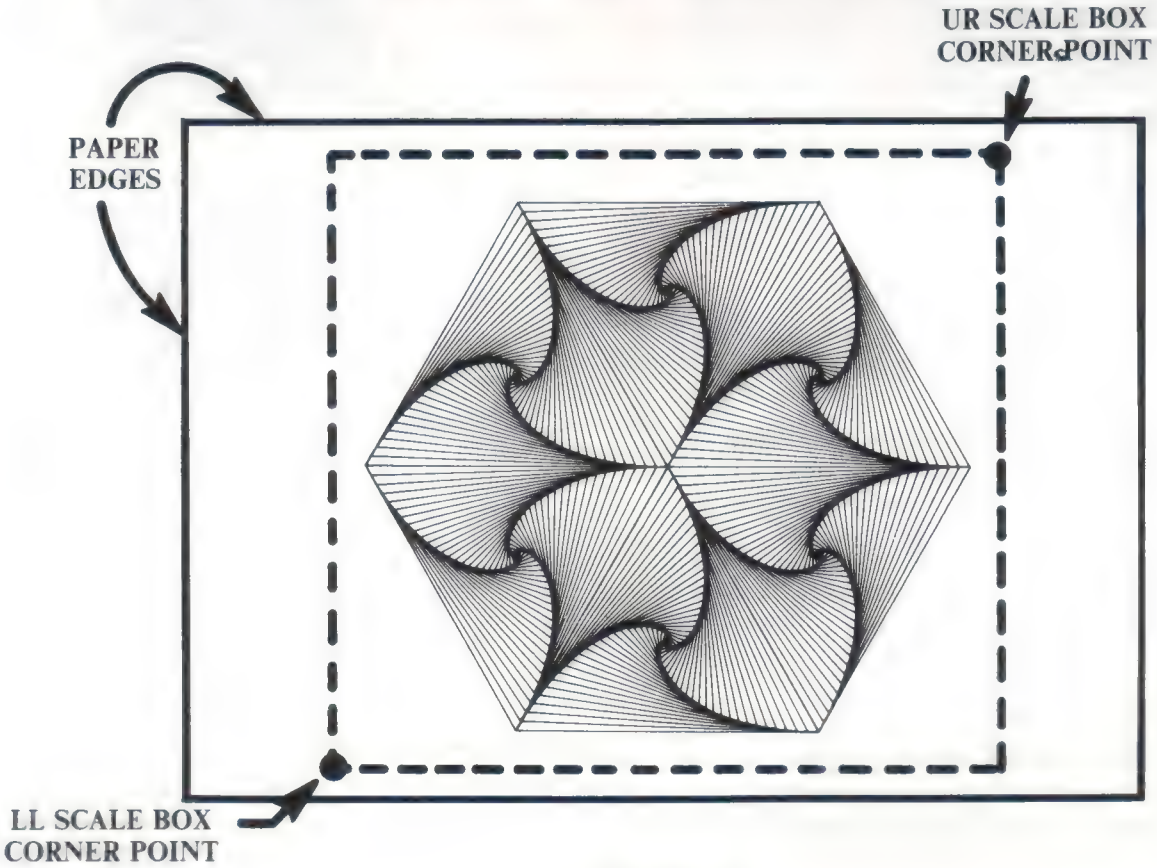


FIGURE 2-5c
A SCALE BOX THREE TIMES THE HEIGHT/LENGTH OF THE WINDOW

The Viewport...

Finally, you have to decide *where* on the paper to place the new subpart plot, or selecting a *Viewport*. This is done by specifying where the lower left corner of the new plot is to be. Since the size and the shape for the new plot has already been determined by the Scale Box rectangle, picking a point where you want the lower left corner of the Scale Box area to appear tells the Plotter just where to draw the new plot. The point that selects the Viewport area is specified by the current position of the Pen Holder. By moving the Pen Holder to a point *below and to the left of which* you want the new plot of the subpart to appear, you determine the location for the new plot when the program is rerun.

Clipping...

In plotter terminology, the entire sequence of using the Window, Scale Box, and Viewport functions on a plot design is called *clipping*, and a plot design that results from clipping is called a *clip*. When the Plotter is commanded to draw a clip from a plot design or during the actual processing of the clip, the pen may pause for various lengths of time. The reason for the pause is that when Window limits are specified, the Plotter still receives the plot codes for the entire plot design but draws only the data for the plot that was placed inside the limits. If the data for the Window plot is not at the beginning of the software program, the pen must wait until that portion of the program is received by the Plotter. If the Plotter is processing Window data and receives plot codes that require the pen to travel outside the limits, the pen will process up to the limit and pause. The pen will resume drawing when the Plotter receives additional Window data.

The Window and Scale Box limits default to the entire plotting area if the Plotter is reset or powered down/up.

To better explain how to set the limits for each function and then use them in sequence to clip a plot design, this manual provides actual clipping exercises in Sections 2.6.2, 2.6.3, and 2.6.4. These exercises DO NOT REQUIRE COMPUTER ASSISTANCE; all activity is initiated from the Plotter's Control Panel. The exercises use the Self-Test plot design to illustrate the clipping procedures. Follow the steps below before proceeding to the exercises.

1. Turn the Plotter's power on (see Section 1.6).

2. Load a clean sheet of large chart paper in the Plotter (see Section 1.7).

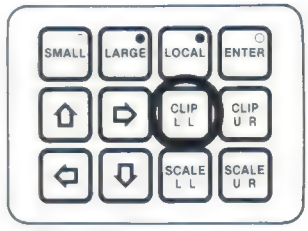
3. Install a pen in the Pen Holder (see Section 1.8).

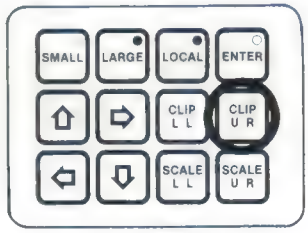
2.6.2 Auto Clipping

The auto clipping function enables you to clip a subpart from a plot design with the Window, and then reproduce it at its original size and aspect without having to scale it. This feature saves time in operations where scaling is not required. The following procedure explains how to specify new lower left (LL) and upper right (UR) corner points for the Window for auto clipping.

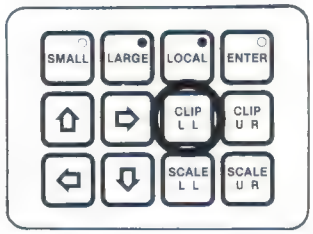
1. Press LOCAL for manual control of the Plotter, and then initiate the Self-Test routine by pressing the ↑ and ↓ buttons simultaneously. The Plotter will draw the Self-Test plot design. After the plot is drawn, press LOCAL to return the Plotter to manual control.

2. This step explains how to see where the current Window limits are located. The Pen Holder will move to the current lower left corner of the Window if CLIP LL is pressed. The pen will move to the current upper right corner of the Window if CLIP UR is pressed.





Return the Pen Holder to the lower left corner by pressing CLIP LL. Notice that the Pen Holder travels the outline of the Window as it moves from corner to corner and that the current Window limits enclose the entire plotting area.



3. The objective of this step is to clip the logo design from the Self-Test plot with the Window. Use the

MANUAL MOVEMENT KEYS to move the Pen Holder to the position of the lower left Window marker illustrated in Figure 2-6. After the Pen Holder is positioned, register this location as the new lower left corner point of the Window by pressing ENTER (the LED indicator will illuminate), and then CLIP LL. (After CLIP LL is pressed, the ENTER indicator will turn off.)

Next, use the MANUAL MOVEMENT KEYS to move the Pen Holder to the position of the upper right Window marker illustrated in Figure 2-6. After the Pen Holder is positioned, register this location as the new upper right corner point of the Window by pressing ENTER (the LED indicator will illuminate), and then CLIP UR. (After CLIP UR is pressed, the ENTER indicator will turn off.)

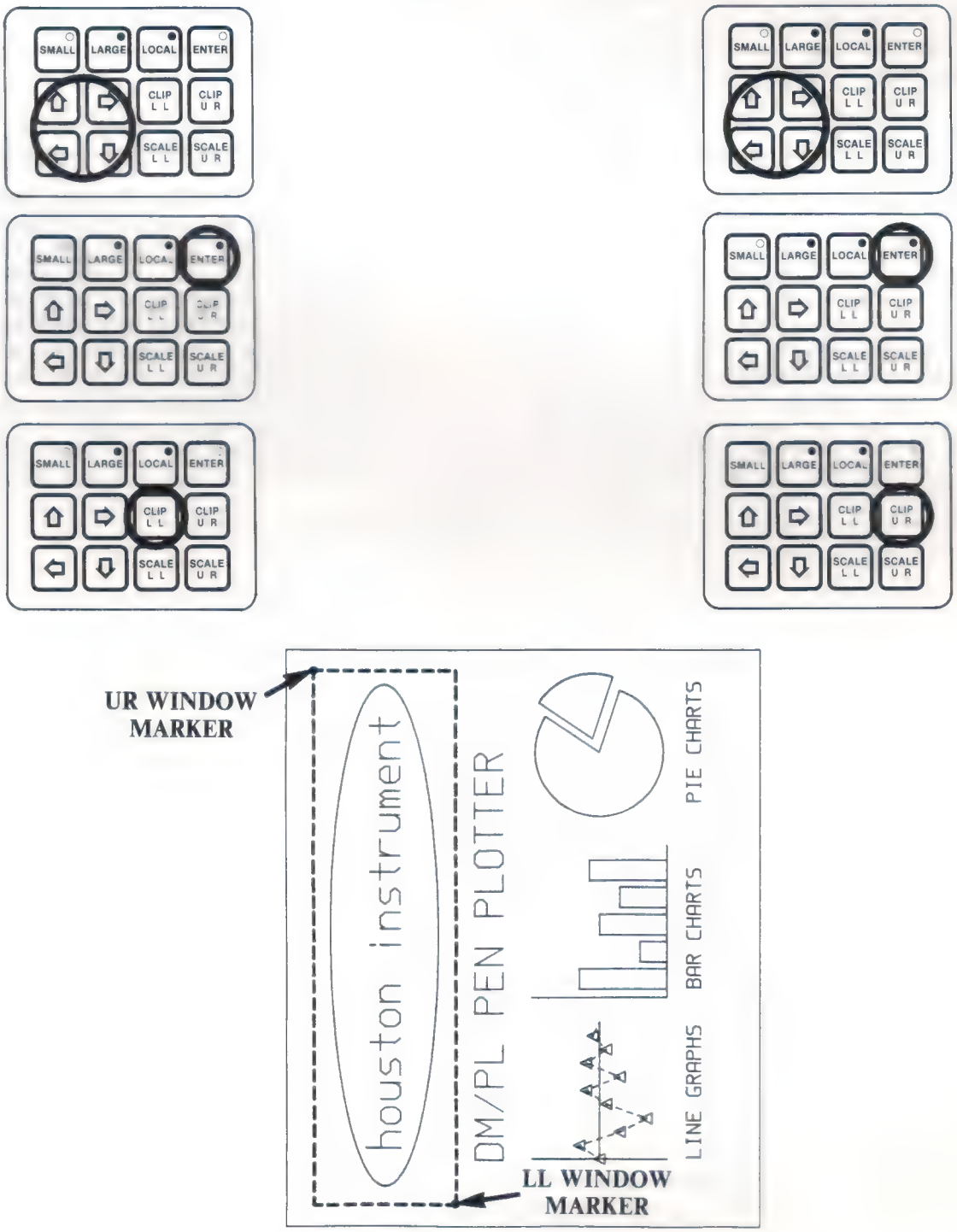


FIGURE 2-6
LOWER LEFT/UPPER RIGHT WINDOW MARKERS

4. The new Window corner points are now set. Jog the Pen Holder around the new Window limits by pressing CLIP LL, then CLIP UR, and then CLIP LL again. The Pen Holder should travel the outline of the logo design.

5. In this step, you will reproduce the design that was clipped in step 3. DO NOT PRESS LARGE OR SMALL (RESET) until after the Plotter has drawn the clip design or the new Window limits will default to full page. Use the MANUAL MOVEMENT KEYS to drive the paper to load position. (Load position is where the edge of the paper is aligned with the front edge of the platen as shown in Figure 1-6.) Remove the paper from the Plotter and replace it with a clean sheet of large paper or use the backside of the used sheet. After changing paper, use the MANUAL MOVEMENT KEYS to move the Pen Holder to the position of the Viewport marker illustrated in Figure 2-7. (This is the point where the Plotter will draw the plot design above and to the right of.) After the Pen is positioned, initiate the Self-Test routine by pressing the ↑ and the ↓ buttons simultaneously. (The Plotter will pause before and during the Self-Test plot. As explained in Section 2.6.1, pen pause is normal when clipping plot designs.) The only design the Plotter will draw is the clipped logo from the Self-Test plot.

2.6.3 Scaling

This section shows you how to change the size and aspect of a plot design using the Scale Box. The plot design used in the following procedure is the Self-Test plot.

1. Press LARGE. This will cause the Window limits that were set in the previous section to default to maximum page.

2. Insert a clean sheet of large chart paper in the Plotter.

3. Press LOCAL. Initiate the Self-Test routine by pressing the ↑ and ↓ buttons simultaneously.

4. Because the Plotter was reset in step 2, the Plotter has maximum Window limits. This means that the Plotter will scale the entire page, which includes the Self-Test plot design, to the dimensions of the Scale Box. Just for fun, let's grossly exaggerate the aspect of the design with Scale Box limits so you'll see the full power and potential of this feature. Press LOCAL, and then use the MANUAL MOVEMENT KEYS to move the Pen Holder to the location specified by the lower left Scale Box marker shown in Figure 2-8. After the Pen Holder is positioned, register this point as the

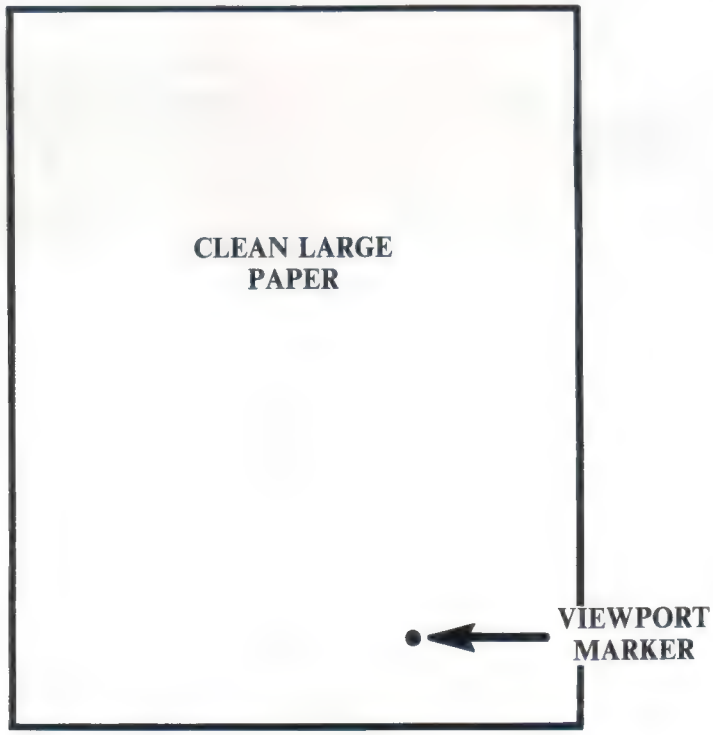


FIGURE 2-7
VIEWPORT MARKER

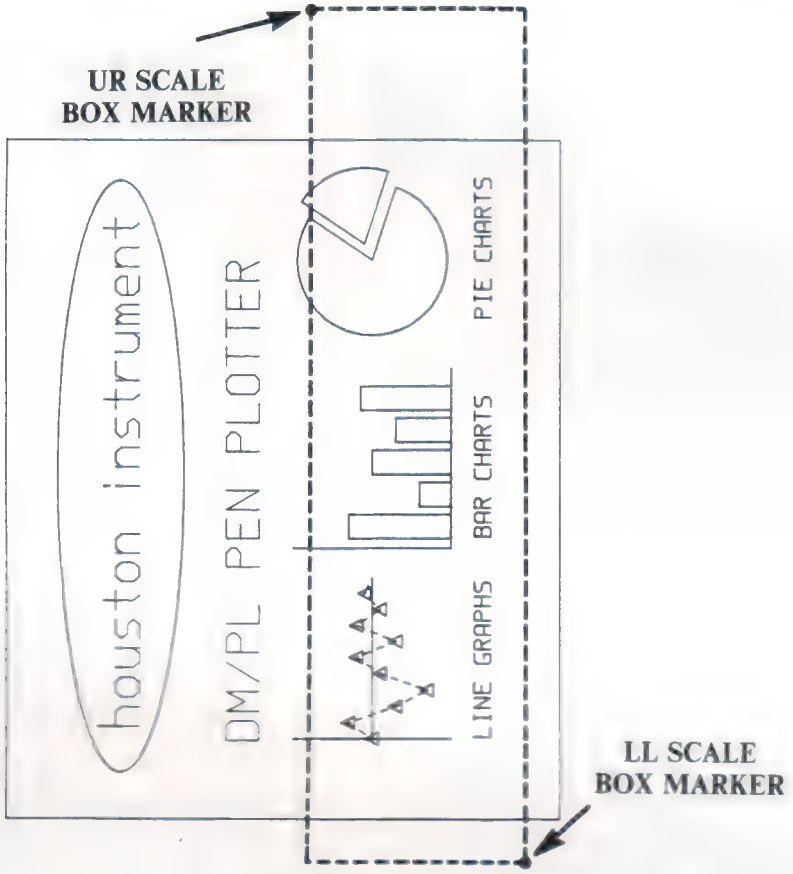
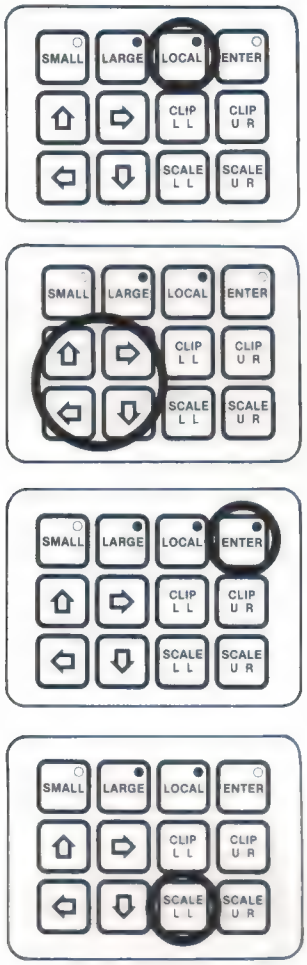


FIGURE 2-8
LOWER LEFT/UPPER RIGHT SCALE BOX MARKERS

FIGURE 2-9
VIEWPORT MARKER

lower left corner of the Scale Box by pressing ENTER and then SCALE LL. (The ENTER indicator will illuminate when ENTER is pressed and will turn off when SCALE LL is pressed.)



Next, use the MANUAL MOVEMENT KEYS to move the Pen Holder to the location specified by the upper right Scale Box marker shown in Figure 2-8. After the Pen Holder is positioned, register this point as the upper right Scale Box corner by pressing ENTER and SCALE UR. (Again, the ENTER indicator will illuminate when ENTER is pressed and will turn off when SCALE UR is pressed.)

5. Use the MANUAL MOVEMENT KEYS to drive the paper to load position. Remove the paper and replace it with a clean sheet of large chart paper or use the backside of the used sheet. After the paper is changed, use the MANUAL MOVEMENT KEYS to move the Pen Holder to the location of the Viewport marker shown in Figure 2-9. Initiate the Self-Test routine by pressing the ↑ and the ↓ buttons simultaneously. The resulting plot design will look similar to the illustration shown in Figure 2-10.

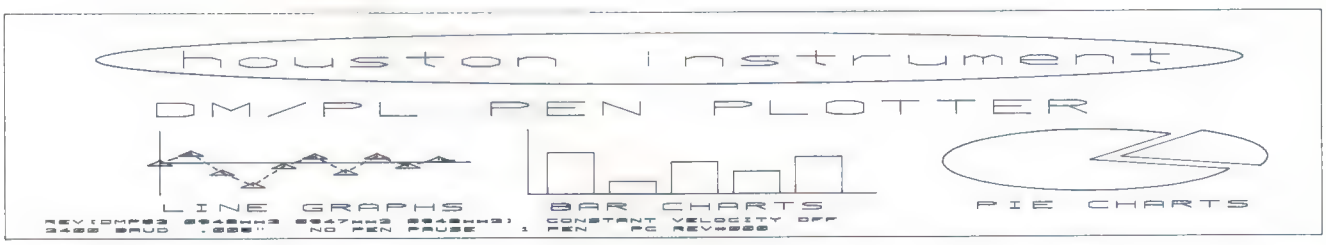


FIGURE 2-10
THE SCALED SELF-TEST PLOT DESIGN

Earlier in this exercise at the beginning of step 4, Window limits were not specified and were used at default maximum. This means not only was the plot design included in the Scale Box area, but all of the empty space on the paper as well. When time permits, repeat this exercise but use the Window to clip the Self-Test plot before specifying the Scale Box limits. By doing so, you'll exclude the empty space from the Scale Box which will increase your precision when specifying the Viewport.

2.6.4 Auto Aspect

Your Plotter has an internally-programmed "auto aspect" feature which ensures a common aspect ratio between an original plot design and its scaled version. This feature is useful during scaling operations that require critical aspect reproductions. The auto aspect feature eliminates possible aspect discrepancies which may occur if locations for new Scale Box corner points are "eyeballed."

For your convenience, there are two ways to scale a plot design using the auto aspect function. But before explaining how to use this feature, the theory of auto aspect must be discussed first. If a lower left and an upper right corner point for a Scale Box are specified *on the same axis*, the Plotter will automatically calculate the axis not specified and draw a perfectly proportioned, scaled reproduction of the original plot design. (The two points can be specified on either the X or the Y axis.) The length of the line formed by the two points determines the size of the scaled design.

The following procedures explain how to scale plot designs using the auto scale function.

1. Press LARGE. This will cause the Window and Scale Box limits that were set in the previous section to default to maximum page.

2. Insert a clean sheet of large paper.

3. Press LOCAL for manual control of the Plotter, and then initiate the Self-Test routine by pressing ↑ and ↓ simultaneously. After the routine completes, press LOCAL again for manual control.

4. In this exercise, you will clip the line graph drawing from the Self-Test design with the Window, and then use the auto aspect function to reproduce it at the original aspect but at a larger size. Use the MANUAL MOVEMENT KEYS to move the Pen Holder to the location indicated by the lower left Window marker shown in the illustration in Figure 2-11. After the Pen Holder is

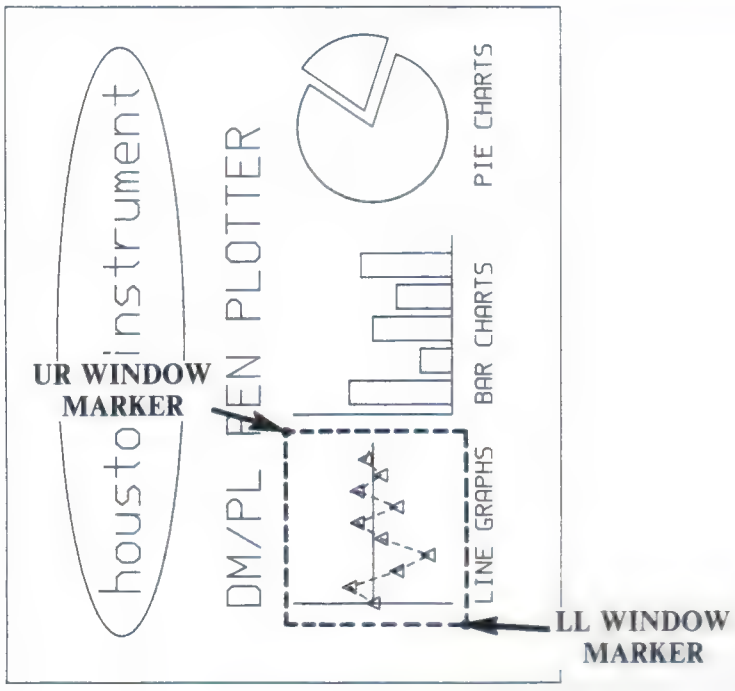
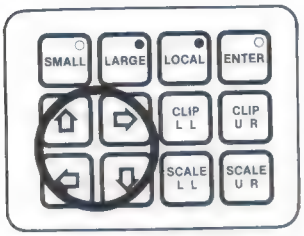
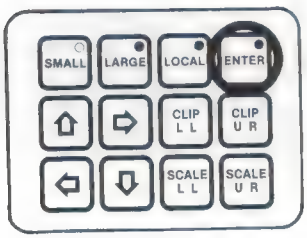
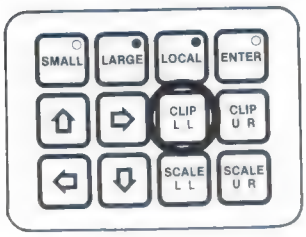


FIGURE 2-11
LOWER LEFT/UPPER RIGHT WINDOW MARKERS

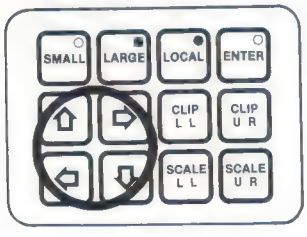
positioned, register this point as the new lower left corner of the Window by pressing ENTER and then CLIP LL.

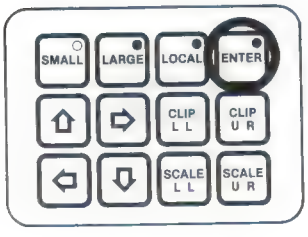




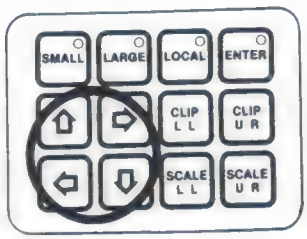


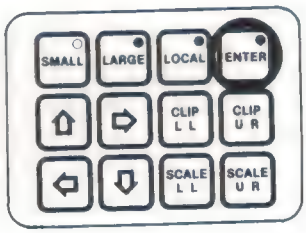
Next, use the MANUAL MOVEMENT KEYS to move the Pen Holder to the location indicated by the upper right Window marker shown in the illustration in Figure 2-11. After the Pen Holder is positioned, register this point as the new upper right corner of the Window by pressing ENTER and then CLIP UR. The line graph design is now clipped from the plot by the Window.

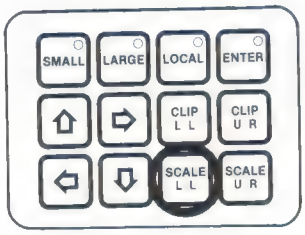




5. Next, you will use the auto aspect feature to "show" the Plotter what size you want the reproduction of the clipped line graph design to be. Use the MANUAL MOVEMENT KEYS to move the Pen Holder to the location indicated by the lower left Scale Box marker shown in the illustration in Figure 2-12. After the Pen Holder is positioned, register its location as the new lower left Scale Box corner by pressing ENTER and then SCALE LL.

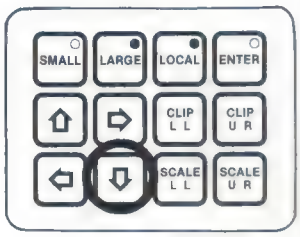


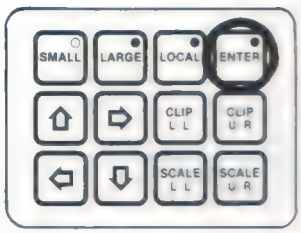


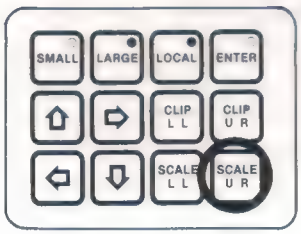


Next, use only the ↓ button to drive the paper forward until the position of the upper right Scale Box marker shown in Figure 2-12 is directly underneath the pen. Register this location as the new upper right Scale Box corner by pressing ENTER and then SCALE UR. **NOTE:** The distance between these two points specifies the length of the X axis for the reproduction of the

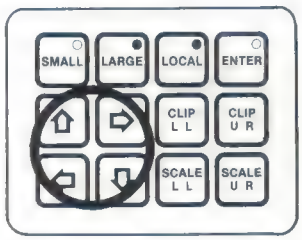
clipped design. The height of the Y axis, which in this case determines the design's aspect, is automatically calculated by the Plotter.







6. Use the MANUAL MOVEMENT KEYS to drive the paper to load position. Remove the paper and insert a clean sheet of large paper or use the backside of the used sheet.



7. Use the MANUAL MOVEMENT KEYS to move the Pen Holder to the location of the Viewport marker shown in Figure 2-13. After the Pen Holder is positioned, initiate the Self-Test routine by pressing the ↑ and ↓ buttons simultaneously. The Plotter will draw a large-scale line graph design which will have identical aspect dimensions as the original plot.

In the last procedure, you were shown how to use the auto aspect function by specifying points along the X axis. Repeat the procedure again, but this time, specify Y axis points for auto aspect by using the lower left and upper right Scale Box markers shown in Figure 2-14 instead of the ones in Figure 2-12 when specifying the Scale Box corners in step 5. Use the ← button instead of the ↓ button to move from the lower left Scale Box corner to the upper right Scale Box corner.

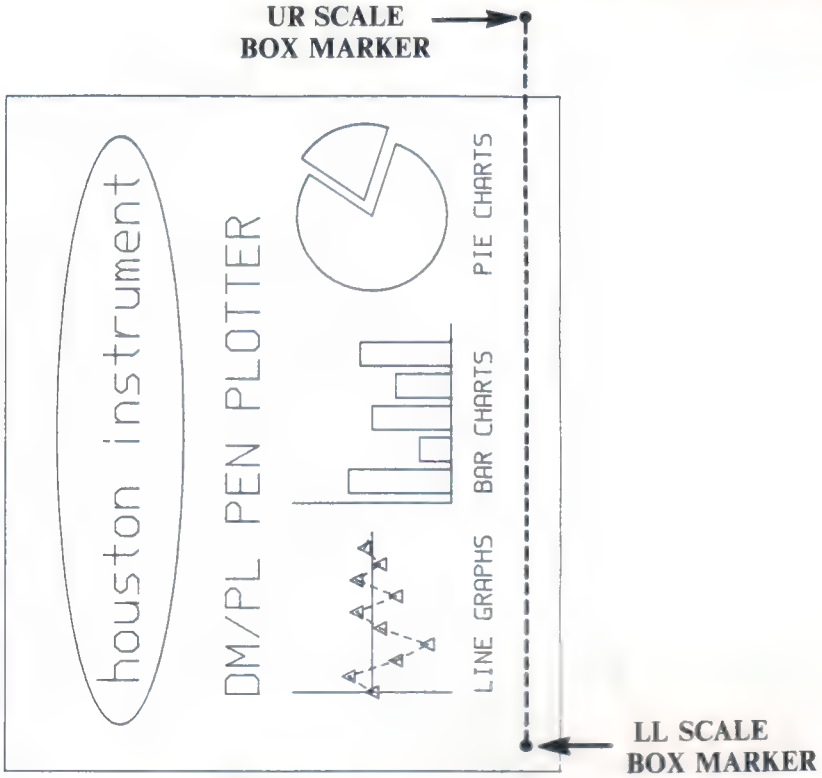


FIGURE 2-12
LOWER LEFT/UPPER RIGHT SCALE BOX MARKERS FOR AUTO ASPECT

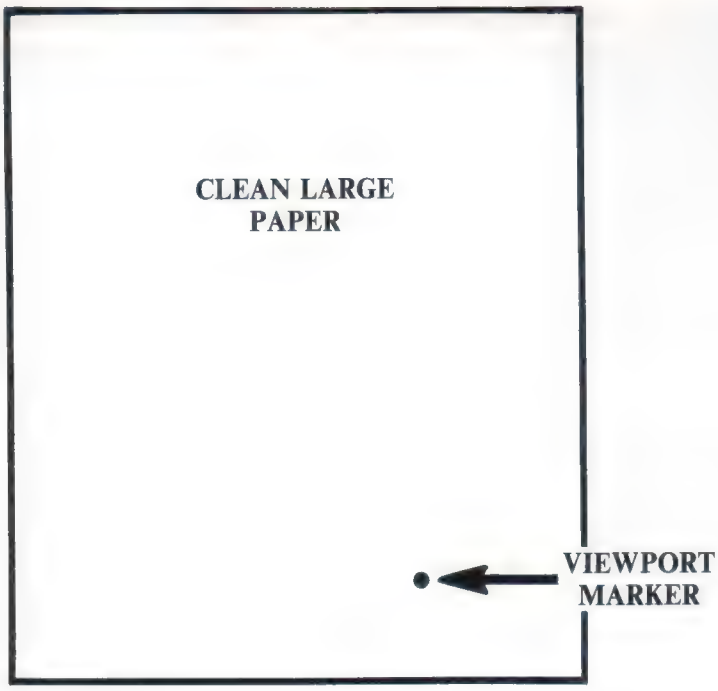


FIGURE 2-13
VIEWPORT MARKER

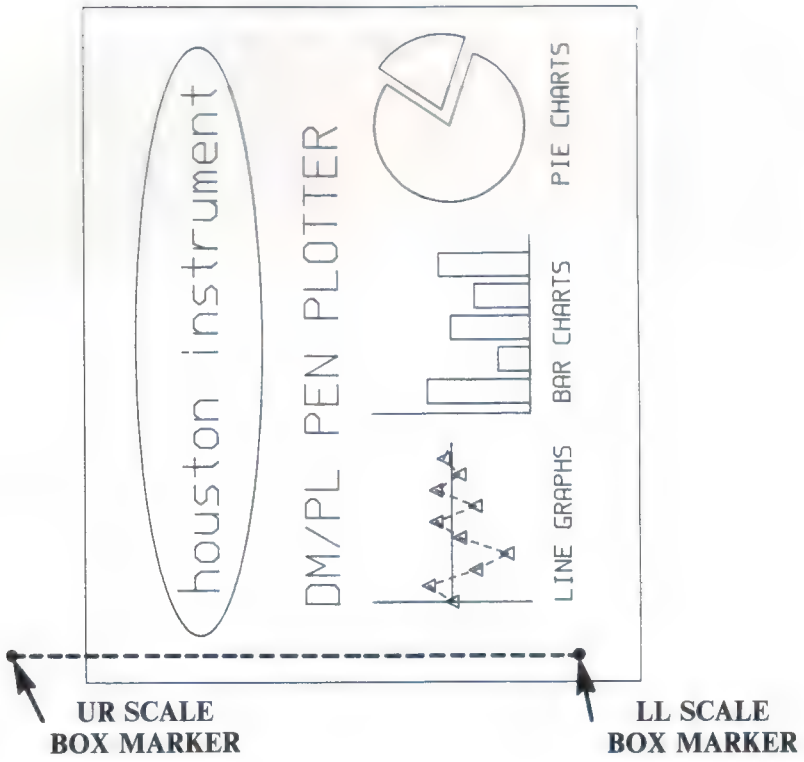


FIGURE 2-14
LOWER LEFT/UPPER RIGHT (Y AXIS) SCALE BOX CORNERS

SECTION 3
DM/PL COMMAND SPECIFICATIONS

3.1 INTRODUCTION

A variety of software packages are available for your Plotter from your distributor; however, you can write your own custom programs using the DM/PL commands.

3.2 DM/PL COMMAND DESCRIPTIONS

The DM/PL commands are described fully in the *DM/PL Command Language Manual* (number MI-1044), which is provided with the Plotter. The DM/PL manual describes all DM/PL commands used with various Houston Instrument plotter models using this language. Table 3-1 lists the commands that are used by your Plotter and describes its parameter capabilities. (If the Plotter receives a command that is listed in the DM/PL manual but not in Table 3-1, then that command simply has no effect.) Use Table 3-1 as a command reference after reading the full descriptions of the commands in the DM/PL manual.

TABLE 3-1
DM/PL COMMANDS

NAME	COMMAND
PLOTTER SELECT COMMANDS:	
Plotter Mode One Select	;:
Plotter Mode Two Select nn = computer prompt code d = time delay, 0 to 255	;:Inn d, or ;:I(nn nn nn nn) d,
Plotter Deselect	@
PLOT SETUP COMMANDS:	
Set Window/Viewport Limits wxll,wyll = window lower left limit coordinates wxur,wyur = window upper right limit coordinates vpxll,vpyll = viewport lower left limit coordinates vpxur,vpyur, = viewport upper right limit coordinates	W wxll,wyll, wxur,wyur, vpxll,vpyll, vpxur,vpyur,
Small Chart (half size)	EH
Large Chart (full size)	EF
Prompt Enable nn = 00 to 7F (hex), default is 5E (caret)	EBnn,

TABLE 3-1
DM/PL COMMANDS
(continued)

NAME	COMMAND
End of Text nn = 00 to 7F (hex), default is 5F (underscore)	ETnn,
Set Velocity n = velocity value (2—16 ips or 5—40 cm/sec)	Vn,
Frame Advance n = number of plot increments to advance	Fn,
ADDRESSING COMMANDS:	
Home Position	H
Set Plot Origin	O
Absolute Pen Positioning x,y = coordinates for next point to be plotted	A x,y,
Relative Pen Positioning x,y = coordinates for next point to move to	R x,y,
Coordinate Addressing n = addressing value 1 = 0.001 inch 5 = 0.005 inch M = 0.1 mm N = 0.025 mm	ECn,
PEN CONTROL COMMANDS:	
Pen Up	U
Pen Down	D
New Pen n = any pen number	Pn,
LINE TYPE COMMANDS:	
Line Type n = line type 0 = —————— 1 = ... 2 = ---------- 3 = ---------- 4 = - - - - - - - - - - 5 = — — — — — — — — 6 = — — — — — — —. 7 = — · — · — · — · — - 8 = — -- — -- — -- —-- 9 = — · — · — · — · - : = — — —	Ln,

TABLE 3-1
DM/PL COMMANDS
(continued)

NAME	COMMAND
MOVE COMMANDS:	
Move to Specified Coordinate nx = x coordinate ny = y coordinate	nx,ny,
Incremental Moves	
+y	p
+x, +y	q
+x	r
+x,-y	s
-y	t
-x,-y	u
-x	v
-x, +y	w
Pen up	y
Pen down	z
TEXT COMMANDS:	
Simple Text r = rotation value 1 = 0° rotation 2 = 90° rotation 3 = 180° rotation 4 = 270° rotation hh = character height specifier CHR$(n) = ASCII character, where n is 32 to 126 decimal __ = exit Symbol Plot	SrhhCHR$(n)__
Extended Text S = parameter set within ( ) is plotted Sn = character height/width, 0 to 255 Wn = character width only, 0 to 255 I = italic character NI = non-italic (block) character Gn = character set 0 = standard ASCII 1 = mathematics 2 = German 3 = French 4 = Swedish 5 = Danish/Norwegian 6 = Spanish 7 = Italian Xn,Yn = line slope point coordinates CHR$(n) = ASCII character, 32 to 126 decimal __ = exit Extended Text	S(Sn,Wn,I/NI, Gn,Xn,Yn)CHR$(n)__

TABLE 3-1
DM/PL COMMANDS
(continued)

NAME	COMMAND
MARKER COMMANDS:	
Marker Plot hh = marker height specifier m = type of marker 0 = plus symbol 1 = x symbol 2 = box symbol 3 = octagon symbol 4 = triangle symbol 5 = double triangle symbol	Mhhm,
Extended Marker Plot (Sn) = marker size (1 to 255) m = type of marker (0 to 5)	M(Sn)m,
CURVE COMMANDS:	
Circle Plot x = center point x coordinate y = center point y coordinate r = radius	CC x,y,r,
Arc Plot x = center point x coordinate y = center point y coordinate d = arc degrees	CA x,y,d,
Ellipse Plot x = center point x coordinate y = center point y coordinate x1 = lateral axis x coordinate y1 = lateral axis y coordinate x2 = vertical axis x coordinate y2 = vertical axis y coordinate	CE x,y, x1,y1 x2,y2
General Curve Plot x1,y1 x2,y2 = coordinate pairs along the desired curve . . . xn,yn = imaginary curve end point coordinate pair CS = exit from General Curve Plot	CG x1,y1, x2,y2, . . . xn,yn, CS
INQUIRY COMMANDS:	
Report	ER
Digitize	ED
Query	Q

TABLE 3-1
DM/PL COMMANDS
(continued)

NAME	COMMAND
PLOTTER CONTROL COMMANDS:	
Plotter Reset	Z
UART Setup nnn = setup value 200 = 7 data bits, no parity, bit 8 = 0, 2 stop bits (default) 201 = 7 data bits, no parity, bit 8 = 1, 2 stop bits 206 = 7 data bits, no parity, bit 8 = odd parity, 2 stop bits 222 = 7 data bits, bit 8 = even parity, 2 stop bits	EUnnn.
Plotter Test	T
Plot Pause	EL

SECTION 4
MAINTENANCE

4.1 OPERATOR MAINTENANCE

Your Plotter has several sliding surfaces. These are made of smooth metals and plastic such that they are essentially friction free and require no lubricants. These will, however, collect dust and lint which will adversely influence your Plotter's performance. Keep your Plotter as clean as possible by using a dust cover. When necessary, clean the unit with a soft cloth and alcohol or mild detergent.

Ink On Plotter Surface:

Use a clean cloth dipped in a concentrated solution of soap and water; squeeze out excess water and then scrub the affected surface. DO NOT use any aerosol cleaners, such as TV contact cleaner, household wall cleaners, or anything containing a solvent; these may damage certain components.

Care of Paper:

Paper should be handled by its edges. Pen skipping may occur if the paper has smudges or has been permeated with oil, grease, perspiration, or other contaminants.

Pen "Tips":

All pens should be capped when not in use for extended periods of time. The ink will dry out when exposed.

4.1.1 Cleaning Drum Grit Wheels

The drum grit wheel area of the plot drum can become clogged with accumulated residue from the plotting materials. This can cause slippage of the plotting material between the plot drum and the pinch rollers, resulting in inaccurate plots.

The following procedure explains how to clean the drum grit wheels when necessary. Note that the special cleaning stips (part number DMP40-303) are available from your Houston Instrument product distributor.

1. Remove plotting material from the unit.

2. Place the Plotter in STATE 1 (local).

3. Remove the protective liner from the cleaning strip.

4. Open the right pinch roller arm.

5. Place the cleaning strip between the pinch roller and the plot drun, with the tacky side of the cleaning strip toward the drum grit wheel as shown in Figure 4-1.

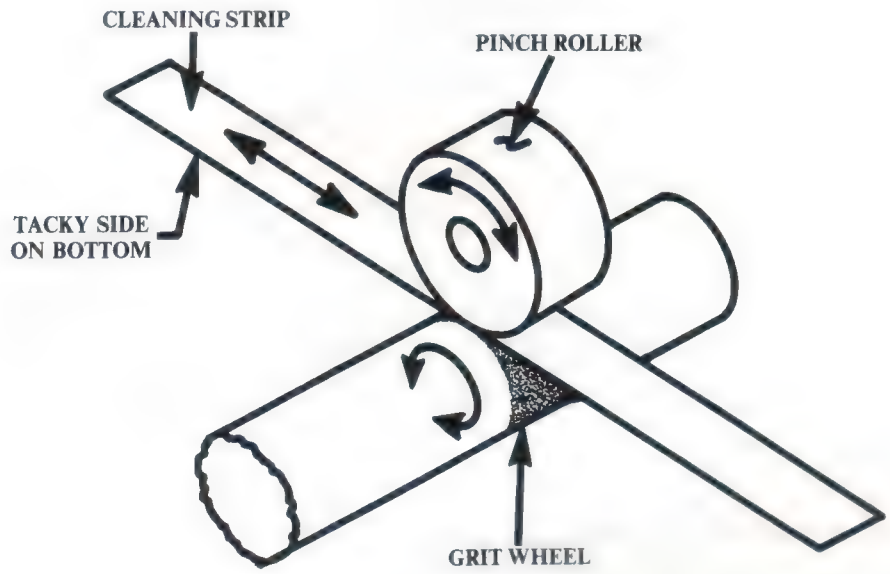


FIGURE 4-1
CLEANING DRUM GRIT WHEELS

6. Using the ↑ and ↓ buttons on the Control Panel, slew the cleaning strip back forth several times until all residue is removed from the drum grit wheel.

7. Open the right pinch roller arm and remove the cleaning strip.

8. Repeat steps four through seven for the left drum grit wheel.

9. Residue can be removed from the cleaning strip by washing it in cold water. Thoroughly dry the cleaning strip and replace its protective lining.

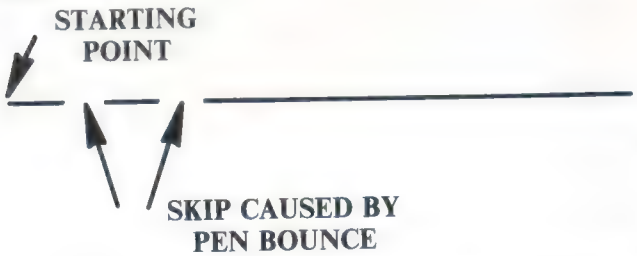
4.1.2 Pen Damper Adjustment

CAUTION

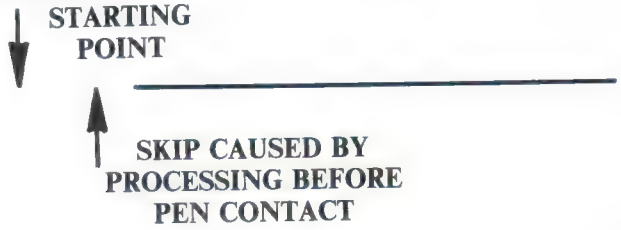
The Plotter's air damper rarely needs adjustments. Do not make the adjustments explained in this section without first trying HI-approved pens, inks, and charts in the Plotter. Most plot quality related problems are caused by inferior supplies — not mechanical malfunctions.

The Plotter uses an air damper to eliminate pen bounce during high speed plotting operations. The damper action of the component may require adjustments from time to time to compensate for normal piston/cylinder wear. This section first shows you how to identify a damper problem, and then how to make the adjustment. (Do not confuse a damper problem with an extended pen down delay time selection from the Menu.)

If the damper action is adjusted too low, the pen may bounce and skip when instructed to lower to the paper surface and draw a line. Below is an example of a line drawn by a Plotter that has its air damper adjusted too low.



If the damper action is adjusted too high, the Plotter may start processing a plot before the pen can make contact with the paper surface. Below is an example of a line drawn by a Plotter that has its air damper adjusted too high.



The following procedure explains how to access the Plotter's air damper and make an adjustment.

1. Turn the power off.

2. Remove the left end cover by loosening the three screws shown in Figure 4-2.

3. The damper's adjustment screw is located on top of the cylinder head (see Figure 4-3). Power up the Plotter and initiate the Self-Test routine. To increase the damper action of the component, turn the adjustment screw clockwise. To decrease its action, turn the adjustment screw counterclockwise.

4. After making your adjustments, turn the power off and replace the end cover and the screws.

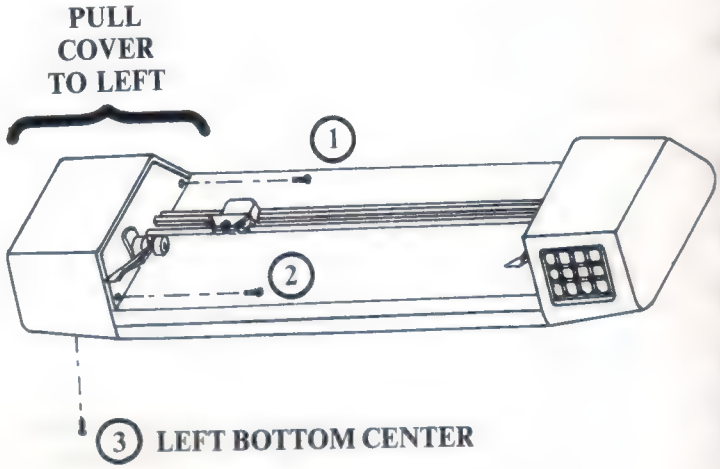


FIGURE 4-2
REMOVING THE LEFT END COVER

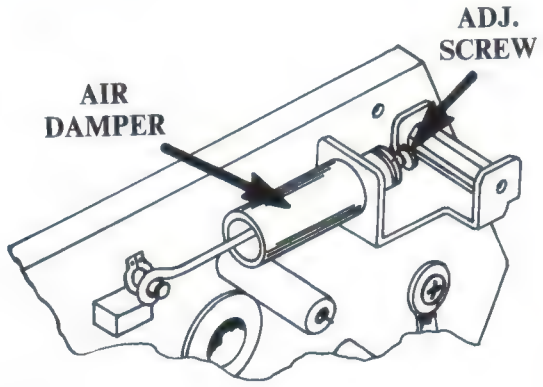


FIGURE 4-3
AIR DAMPER ADJUSTMENT SCREW

4.2 OPERATING VOLTAGE CONVERSION

The Plotter operates on either 100, 120, 220, or 240 VAC (±10%) line voltage. To convert the Plotter's operating voltage, follow the procedure below.

1. Turn the Plotter's power off.
2. Unplug the ends of the power cord from the AC wall outlet and from the AC receptacle on the bottom panel of the Plotter.
3. Slide the protective window to the left (see Figure 4-4).
4. Pull the "FUSE PULL" lever out and remove the fuse.
5. Pull the voltage select board, which is located inside the fuse cavity below the fuse holder, out from the fuse cavity.

   As shown in Figure 4-4, one side of the voltage select board has the numbers "120" and "240" printed on it, and the other side has the numbers "220" and "100." The numbers indicate the operating voltage of 120, 240, 220, and 100 VAC. Hold the board in your hand so that the number that reflects the desired operating voltage ("100," "120," "220," or "240") appears upright on the left side of the voltage select board. (The other number will appear upside down.) While holding the board in this position, slide it back into its place inside the fuse cavity (see Figure 4-4). The number that indicates the operating voltage will now be visible from the outside of the fuse cavity window.

WARNING

Do not re-install the fuse that was removed in step 4. The fuse rating for 100/120 VAC and 220/240 VAC are different and must correspond to the operating voltage to prevent possible damage to the Plotter. If you are converting the Plotter to either 100 or 120 VAC, install a 250V 3AG 1.0 AMP fuse. If you are converting it to 220 or 240 VAC, install a 250V 3AG .5 AMP fuse.

6. Close the protective window over the fuse cavity by sliding it to the right.
7. Connect the power cord. The Plotter is now ready to be operated on the selected AC line voltage.

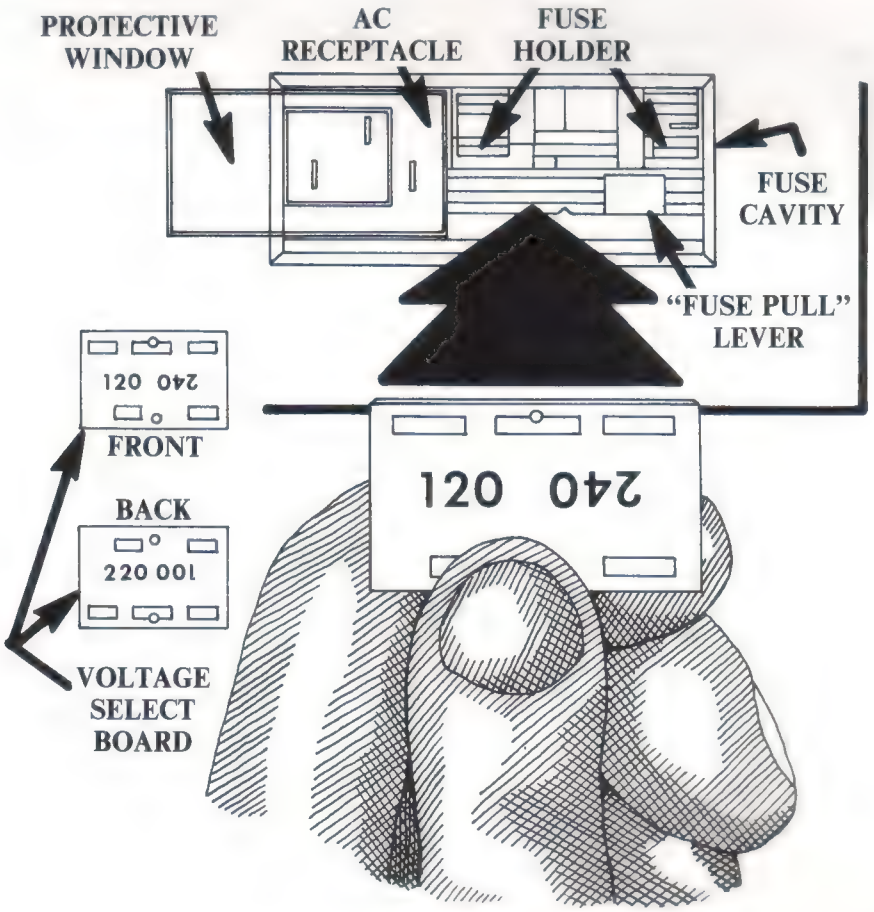


FIGURE 4-4
EXAMPLE OF 120 VAC CONVERSION

SECTION 5
PARTS LISTS AND SCHEMATICS

5.1 PARTS LISTS

This section contains the assembly drawings and parts lists for the DMP-51 and DMP-52. Use the assembly drawings to locate the needed parts and then refer to the accompanying parts list for information on that part.

Always include the following information when ordering parts:

- The model number of the Plotter.
- The serial number of the Plotter.
- The part number of the required component.
- A description of the required component.

The Plotter model and serial numbers are found on the label attached to the bottom of the unit. The part number and a description of each component are listed in this section.

All parts must be ordered from your local Houston Instrument product distributor.

5.1.1 Organization

Figures 5-1, 5-2a, 5-2b, and 5-2c show the complete DMP-51/52 Plotter. Figure 5-3 shows the Logic board assembly used in the units. Unless otherwise noted in the accompanying parts lists, the components shown in these illustrations are used in both the DMP-51 and DMP-52 Plotters.

To use the parts lists, find the circled reference number of the part you need in the illustrations. Use Table 5-1 with Figure 5-1, Table 5-2 with Figures 5-2a, 5-2b, and 5-2c, and Table 5-3 with Figure 5-3 to locate that number. Each component has six columns of information in the parts list. The REF. NO. column is a listing of the reference numbers.

The LEVEL column indicates the relative level of subordination of the part to help you find the next higher level assembly, if needed. For example, a part at LEVEL 3 is a subassembly of the preceding part of the same assembly at LEVEL 2, while a part of the same assembly at LEVEL 4 is subordinate to the preceding part at LEVEL 3.

The DESCRIPTION, PART NUMBER, REV (revision), and QTY (quantity) of each each part are also listed for ordering purposes.

Following the parts lists are the Logic board schematics.

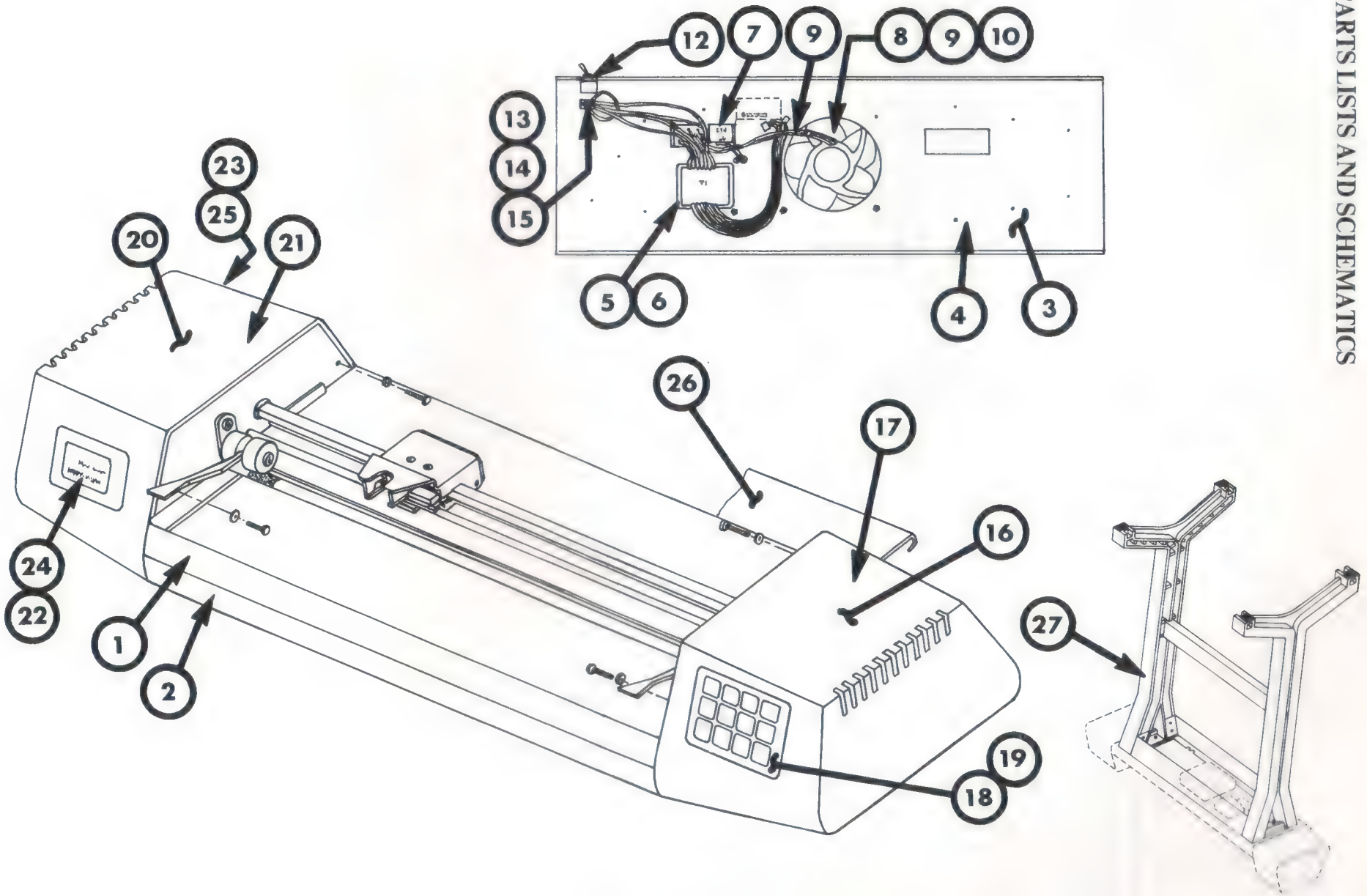


FIGURE 5-1
TOP AND BOTTOM ASSEMBLY

TABLE 5-1
TOP AND BOTTOM ASSEMBLY PARTS LIST

REF NO.	LEVEL	DESCRIPTION	PART NUMBER	REV.	QTY
1	1	ASSY, SERVO PLOTTER	DMP-51/52		1
2	2	ASSY,COVER,DMP-52	DMP52-135		1
		ASSY,COVER,DMP-51	DMP51-296		1
3	3	ASSY,BOTTOM COVER DMP-52	DMP52-110		1
		ASSY,BOTTOM COVER DMP-51	DMP51-185		1
4	4	COVER,BOTTOM DMP-52	DMP52-109		1
		COVER,BOTTOM DMP-51	DMP51-174		1
5	4	ASSY,TRANSFORMER	DMP51-206	C	1
6	5	TRANSFORMER	DMP51-205		1
7	6	FUSE,1AMP SLO BLO	MF-35		1
8	4	ASSY,FAN	DMP51-209	A	1
9	5	ASSY,CABLE,FAN	DMP51-210	A	2
10	5	FAN, A30045-10	MF-80		1
11	6	GUARD,FAN	MF-67		1
12	4	SWITCH,TOGGLE	MS-640		1
13	5	ASSY,CABLE,SW/CONN,BLK.	DMP51-212	C	1
14	6	ASSY,CABLE,BLK,SW/CONN.	DMP51-211	A	1
15	6	ASSY,CABLE,SW/CONN,WHT.	DMP51-213	A	1
16	3	ASSY,RIGHT SIDE	DMP51-299		1
17	4	COVER,END	DMP51-181		1
18	5	SWITCH,MEMBRANE	DMP51-201		1
19	6	DECAL,MEMBRANE SWITCH	DMP51-204		1
20	3	ASSY,LEFT SIDE	DMP51-300		1
21	4	COVER,END	DMP51-181		1
22	5	BEZEL LOGO	DMP51-288		1
23	5	DECAL,REAR PANEL	DMP51-203		1
24	5	DECAL,NAMETAG,STANDARD	DMP51-290		1
25	5	LABEL,FUSE SPEC	DMP-1234		1
26	3	PLATEN EXTENSION DMP-52	DMP52-122		1
		PLATEN,EXTENSION DMP-51	DMP51-242		1
27	1	ASSY,STAND	DMP51-208	D	1

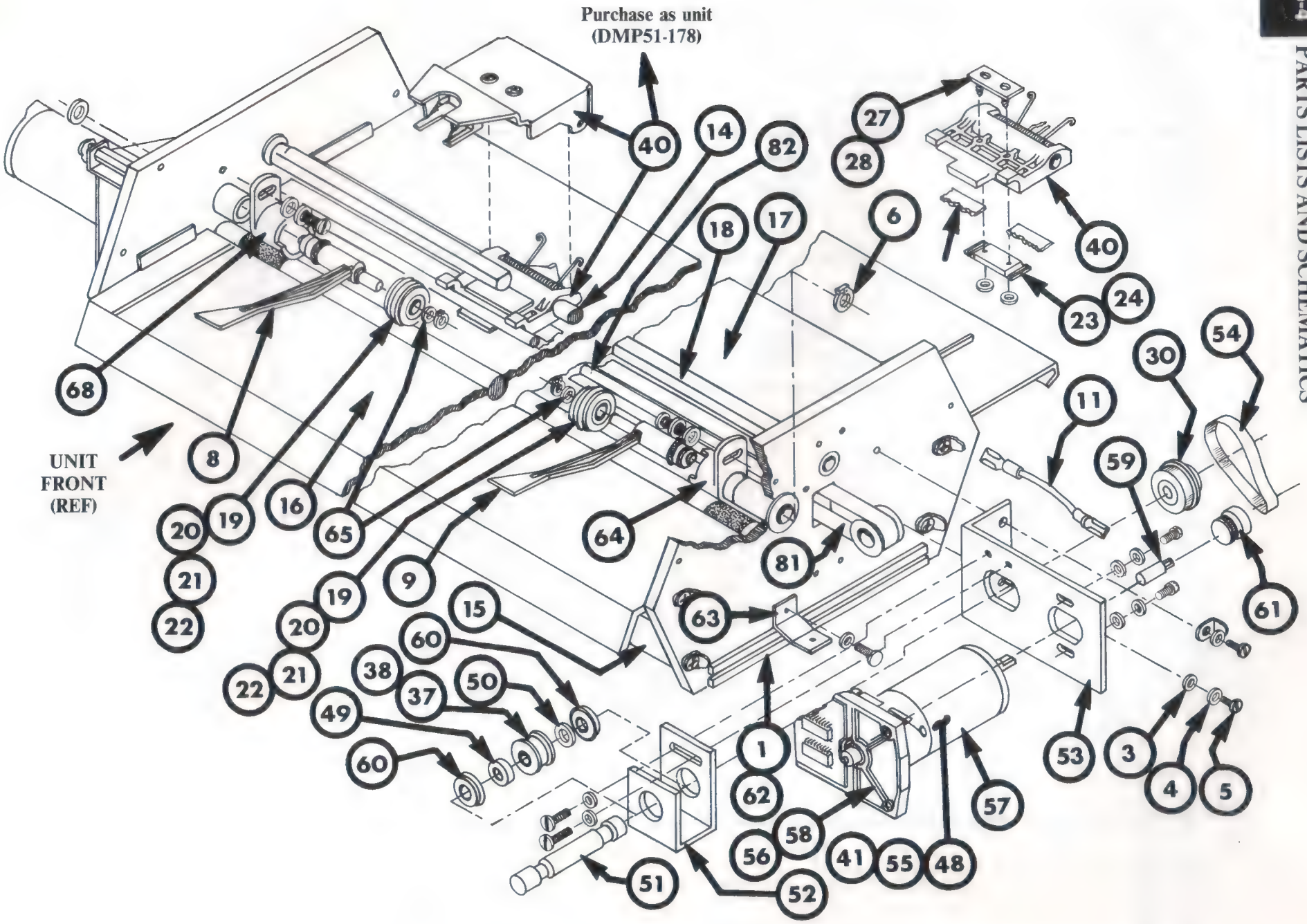


FIGURE 5-2a
Y-AXIS AND PLATEN ASSEMBLY

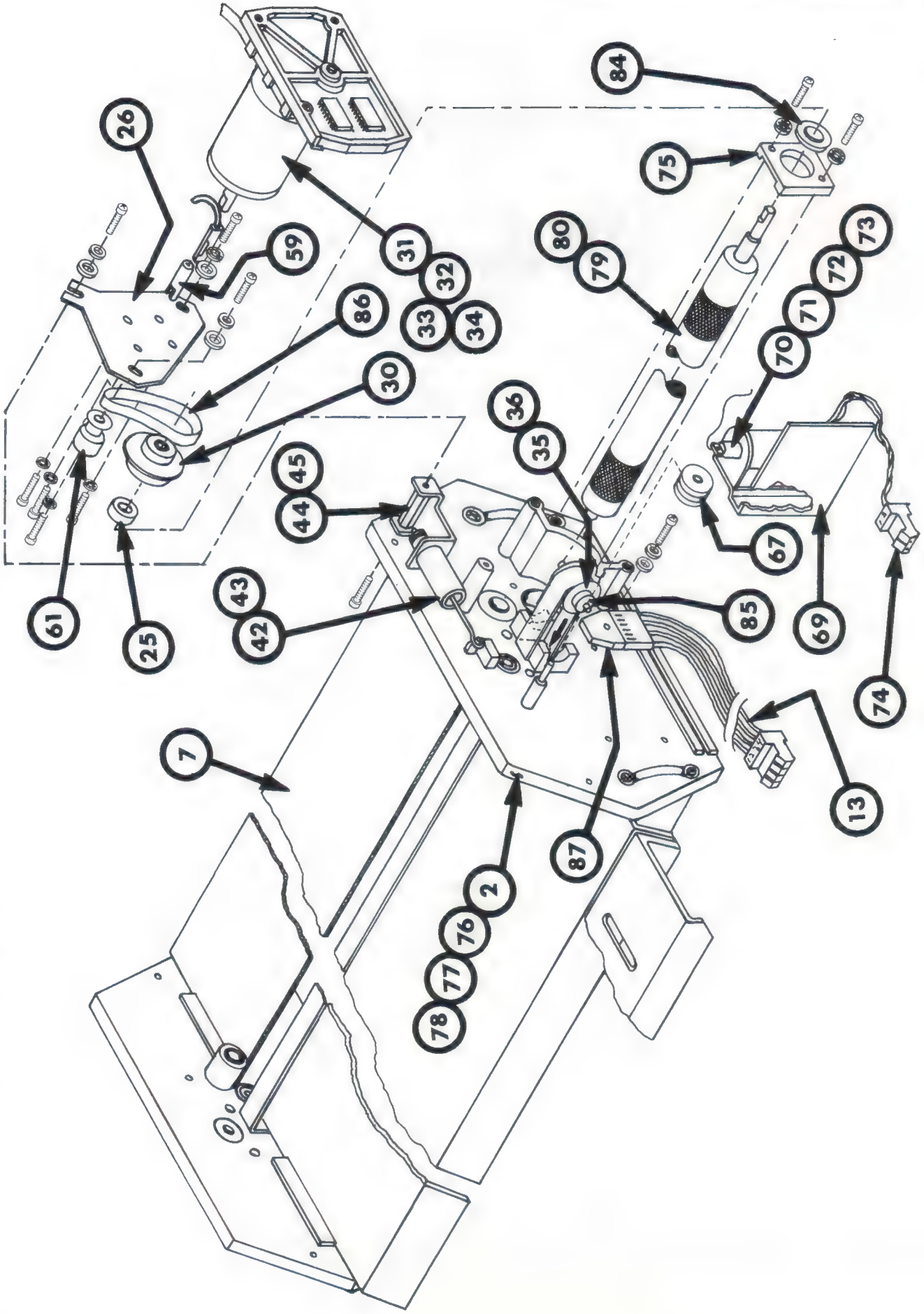


FIGURE 5-2b
X-AXIS AND PEN LIFT ASSEMBLY

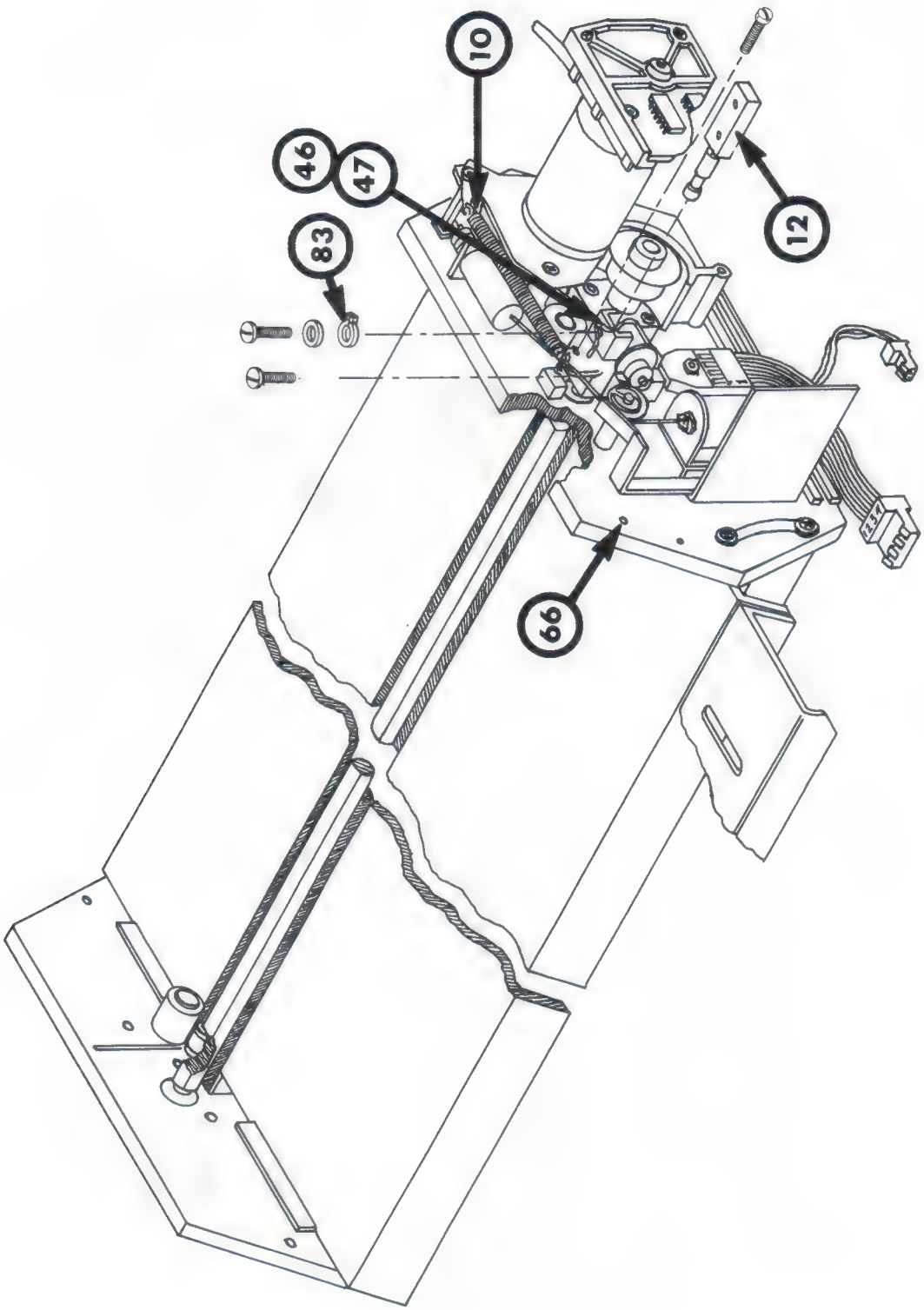


FIGURE 5-2c
PEN LIFT INSTALLED

TABLE 5-2
X-Y DRIVE/PLATEN/PEN LIFT ASSEMBLY PARTS LIST

REF NO.	LEVEL*	DESCRIPTION	PART NUMBER	REV.	QTY
1	4	ASSY,RIGHT COVER	DMP51-182	B	1
2	4	ASSY,LEFT COVER	DMP51-183	B	1
3	—	ALL FLAT WASHER HARDWARE	N/A		
4	—	ALL LOCK WASHER HARDWARE	N/A		
5	—	ALL SCREW HARDWARE	N/A		
6	—	ALL SNAP RING HARDWARE	N/A		
7	3	ASSY,MAINFR.,DMP52 BASIC	DMP52-137		1
		ASSY,MAINFR.,DMP51 BASIC	DMP51-295		1
8	3	ROLLER,CAM-PINCH,LEFT	DMP40-256		1
9	3	ROLLER,CAM-PINCH,RIGHT	DMP40-3		1
10	3	SPRING,PEN LIFT	DMP40-33		1
11	4	ASSY,JUMPER GROUNDING	DMP40-80	A	3
12	3	ADAPTER,PEN LIFT BAR	DMP41-130		1
13	4	ASSY,SENSOR CABLE	DMP41-36	E	1
14	3	BAR,PEN,REAR	DMP42-12		1
15	3	ROD,SUPPORT DMP-52	DMP42-13		2
		ROD,SUPPORT DMP-51	DMP41-1		2
16	3	PLATEN,FRONT,FINISHED DMP-52	DMP42-7		1
		PLATEN,FRONT,FINISHED DMP-51	DMP41-8		1
17	3	PLATEN,REAR,FINISHED DMP-52	DMP42-8		1
		PLATEN,REAR,FINISHED DMP-51	DMP41-7		1
18	3	ROD,PEN LIFT DMP-52	DMP42-9		1
		ROD,PEN LIFT DMP-51	DMP41-6		1
19	4	ASSY,CAM ROLLER	DMP51-111	B	2
20	5	CAM ROLLER,MOLDED	DMP51-110		1
21	5	ROLLER,CAM,MODIFIED	DMP51-157		1
22	4	BEARING,ABEC 3 CLASS	MB-242		2
23	4	CLAMP,BELT	DMP51-115		1
24	5	EXTRUSION,CLAMP,BELT	DMP51-200		.1 FT
25	3	SPACER,BEARING	DMP51-118		1
26	3	MOUNT,MOTOR,X AXIS B OPT.	DMP51-128		1
27	4	ASSY,BELT PLATE	DMP51-146		1
28	4	PLATE,BELT	DMP51-145		1
29	3	PULLEY,TIMING BELT	DMP51-162		1
30	3	PULLEY,TIMING BELT	DMP51-163		1
31	4	ASSY,MOTOR X AXIS W/ENC.	DMP51-166	B	1
32	4	PLATE,ENCODER	DMP51-161		1
33	4	MOTOR X DRIVE	MM-202		1
34	4	ENCODER	MM-204		1
35	4	ASSY,IDLER PULLEY Y AX.	DMP51-175		1
36	4	SHAFT,Y AXIS IDLER PULLEY	DMP51-143		1
37	5	ASSY,PULLEY,Y AXIS	DMP51-155		1
38	5	PULLEY	DMP51-154		1
39	5	BUSHING,FLANGE,I.D.	MB-246		2
40	4	ASSY,PEN HOLDER	DMP51-178		1
41	4	ASSY,CABLE MOTOR	DMP51-192	C	2
42	4	ASSY,AIRPOT BRKT.	DMP51-236		1
43	4	BUSHING,DASH POT	DMP51-234		1
44	4	BRACKET,DASH POT	DMP51-235		1
45	4	DASHPOT,PULL ONLY,MTG.	MD-161		1
46	4	ACTUATOR,PEN,MOD.	DMP51-237		1
47	4	ACTUATOR,PEN	DMP40-196		1

* LEVELS 1 and 2 for this parts list are listed in Table 5-1.

TABLE 5-2
X-Y DRIVE/PLATEN/PEN LIFT ASSEMBLY PARTS LIST (Continued)

REF NO.	LEVEL*	DESCRIPTION	PART NUMBER	REV.	QTY
48	4	ASSY,MOTOR,Y AXIS	DMP51-298		1
49	4	COLLAR	2000-169		1
50	4	WASHER,THRUST	6520-86		1
51	4	SHAFT,Y AXIS DRIVE	DMP51-116		1
52	5	BRACKET,PULLEY	DMP51-122		1
53	5	MOUNT,Y AXIS,MOTOR	DMP51-123		1
54	4	BELT,TIMING	DMP51-164		1
55	5	ASSY,MOTOR Y AXIS,W/ENC.	DMP51-167	B	1
56	5	PLATE,ENCODER	DMP51-161		1
57	5	MOTOR,Y DRIVE	MM-203		1
58	5	ENCODER	MM-204		1
59	4	BUSHING,MOTOR SHAFT	DMP51-227		1
60	4	BEARING NMB NO.	MB-8		2
61	4	PULLEY,.080 PITCH X 16	MP-721		1
62	3	ASSY,RIGHT SIDE	DMP51-299		1
63	4	BRACKET,SUPPORT,RIGHT/LEFT	DMP40-292		1
64	4	CAM STOP,RIGHT	DMP40-9		1
65	4	WASHER,7/16 OD X .20 ID,	MW-925		1
66	3	ASSY,LEFT SIDE	DMP51-300		1
67	4	PULLEY,PEN LIFT	DMP40-24		1
68	4	CAM STOP,LEFT	DMP40-8		1
69	5	ASSY,PEN LIFT SOLENOID	DMP41-125	B	1
70	7	ASSY,PLUNGER AND CORD	DMP40-173		1
71	7	PLUNGER,SOLENOID	DMP40-138		1
72	7	CORD,DIAL,DACRON	MC-1813		.3 FT
73	6	CUSHION	HR29-134		1
74	6	CONN 2 PIN FEM	MC-1453		1
75	4	ADAPTER,BEARING	DMP51-120		1
76	5	ASSY,END PLATE,LEFT	DMP51-139	A	1
77	6	PLATE,LEFT END MOD.	DMP51-130		1
78	7	ASSY,PLATE,LEFT END	DMP40-4	M	1
79	4	SHAFT,DRIVE DMP-52	DMP52-108		1
		SHAFT,DRIVE DMP-51	DMP51-151		1
80	4	SHAFT,DRIVE,MACHINED DMP-52	DMP52-107		1
		SHAFT,DRIVE,MACHINED DMP-51	DMP51-177		1
81	4	BELT,TIMING,Y AXIS DMP-52	DMP52-111		1
		BELT,TIMING,Y AXIS DMP-51	DMP51-164		1
82	3	PEN BAR,FRONT DMP-52	DMP52-133		1
		PEN,BAR,FRONT DMP-51	DMP51-277		1
83	3	CLAMP,CABLE	HR29-149		1
84	3	BEARING, NMB	MB-126		1
85	3	BEARING,LUB.ANDOK C	MB-212		2
86	3	BELT,TIMING,.080 PITCH,	MB-245		1
87	4	OPTO SEN OPB709 OPTRON	MW-846		1

*LEVELS 1 and 2 for this parts list are listed in Table 5-1.

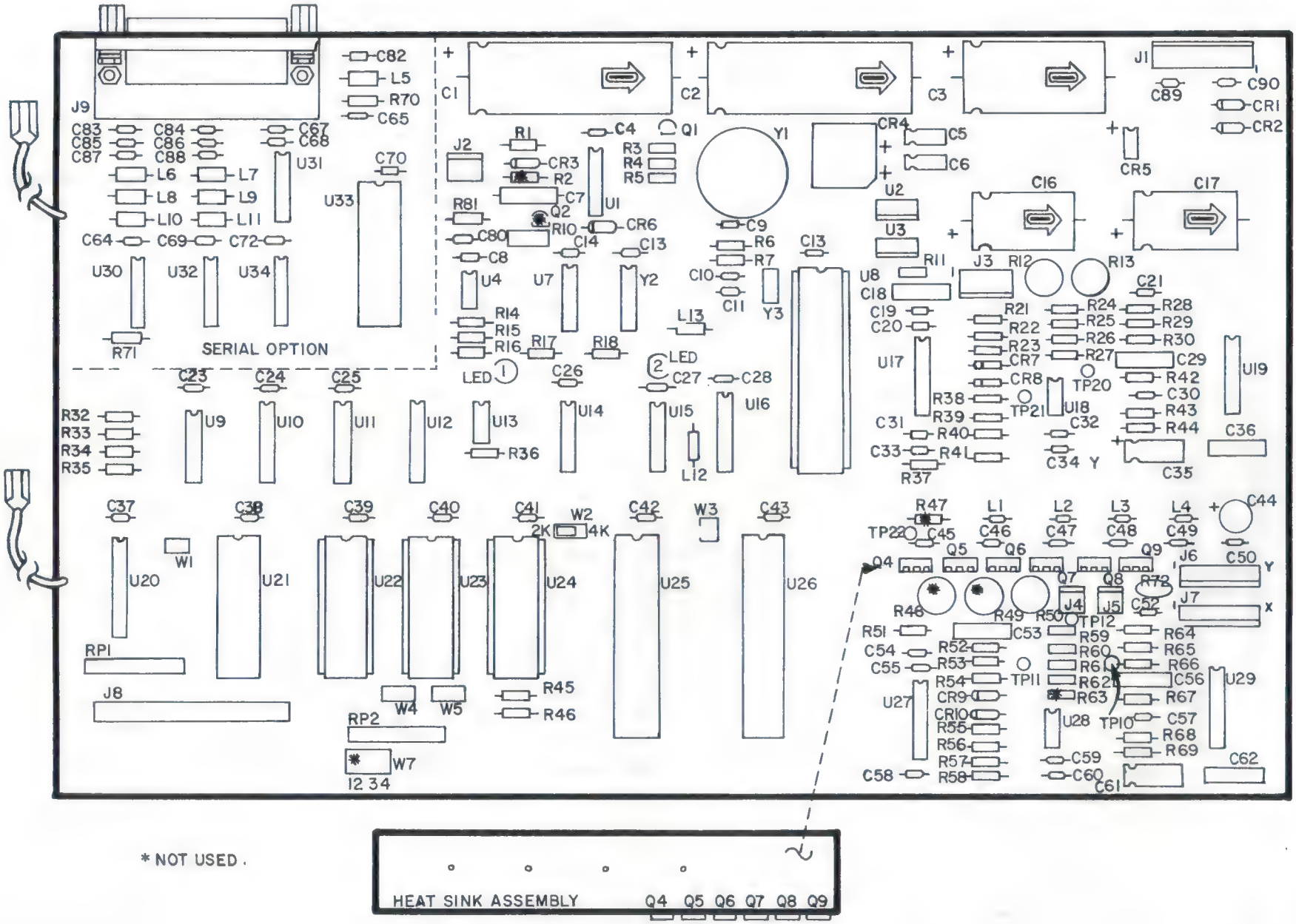


FIGURE 5-3
LOGIC BOARD CIRCUIT ASSEMBLY

TABLE 5-3
LOGIC BOARD PARTS LIST

REF NO.	LEVEL*	DESCRIPTION	PART NUMBER	REV.	QTY
	3	ASSY,LOGIC BD,FINAL	DMP51-297		1
PT1	5	ASSY,PIGTAIL,GROUNDING	DMP40-79	B	2
PT2					
L12	5	ASSY,RFI CHOKE	DMP51-289	A	2
L13					
	5	BEAD,FERRITE	MB-251		1
L1	4	BEAD,FERRITE	MB-118		11
L2					
L3					
L4					
L5					
L6					
L7					
L8					
L9					
L10					
L11					
C10	4	CAP 10PF V J%CE	MC-1191		2
C11					
C44	4	CAP 100MF 16V	MC-1259		1
W2	4	CONN 3 PIN MALE	MC-1292		1
W3	4	CONN 2 PIN MALE	MC-1365		1
J2	4	CONN 2 PIN MALE	MC-1458		1
J1	4	CONN 6 PIN MALE	MC-1480		1
J6	4	CONN 7 PIN MALE	MC-1683		2
J7					
C4	4	CAP .01MF 50V A%	MC-1697		39
C8					
C9					
C13					
C14					
C15					
C19					
C23					
C24					
C25					
C26					
C27					
C28					
C31					
C32					
C33					
C34					
C37					
C38					
C39					
C40					
C41					
C42					
C43					
C50					
C54					

TABLE 5-3
LOGIC BOARD PARTS LIST (continued)

REF NO.	LEVEL*	DESCRIPTION	PART NUMBER	REV.	QTY
C58					
C59					
C60					
C64					
C67					
C68					
C69					
C70					
C72					
C80					
C82					
C89					
C90					
C20	4	CAP 100PF 50V K%	MC-1699		6
C21					
C30					
C52					
C55					
C57					
C83	4	CAP 390PF 50V K%	MC-1701		6
C84					
C85					
C86					
C87					
C88					
J3	4	CONN 4 PIN MALE	MC-1713		1
C3	4	CAP 3300MF 35V	MC-1806		1
J8	4	CONN 19 PIN MALE	MC-1810		1
J4	4	CONN 2 PIN	MC-1824		2
J5					
C65	4	CAP .1MF 50V A%	MC-1872R		1
C46	4	CAP .001MF 100V M%CE	MC-1892R		4
C47					
C48					
C49					
Y2	4	CRYSTAL OSC. 4MHZ HS-180P	MC-1904		1
C1	4	CAP 4700 MF 25V	MC-1906		2
C2					
C35	4	CAP 2.2MF 25V	MC-1907		2
C61					
C16	4	CAP 1000MF 25V	MC-1914		2
C17					
C29	4	CAP .01MF 630V J%	MC-1915		4
C36					
C56					
C62					
J9	4	CONNECTOR,BURNDY	MC-1932		1
Y3	4	CRYSTAL,NEL MPC18	MC-3227		1
C18	4	CAP .0047MF 250V K%	MC-379		2
C53					
C7	4	CAP .1MF 100V K%	MC-381		1
C45	4	CAP .47MF	MC-5063		1

TABLE 5-3
LOGIC BOARD PARTS LIST (continued)

REF NO.	LEVEL*	DESCRIPTION	PART NUMBER	REV.	QTY
C5	4	CAP 10MF 35V	MC-542		2
C6					
LED1	4	LED MV5752 GI	MD-159		2
LED2					
CR4	4	DIODE ATBR605 ATL 50V 6A	MD-162		1
CR1	4	DIODE 1N4005 PC 600V 1A	MD-25		2
CR2					
CR3	4	DIODE 1N3070	MD-8		6
CR6					
CR7					
CR8					
CR9					
CR10					
Y1	4	TRANSDUCER, AUDIBLE AT20	MI-297		1
MJ-2	4	JUMPER, AMP 531220-1	MJ-2		1
R13	4	POT 1K HELITRIM #91AR1K	MP-501		2
R50					
R12	4	POT,10K	MP-752		1
Q1	4	TRANSISTOR MPS6520	MQ-26		1
R26	4	RES 220 OHM 5%1/3W F	MR-107		4
R27					
R61					
R62					
R38	4	RES 4.99K OHM 1%1/8W M	MR-1180		4
R39					
R55					
R56					
R41	4	RES 3.9M OHM 10%1/4W F	MR-1380		1
R58	4	RES 6.8M OHM 10%1/4W C	MR-1391		1
R72	4	RES PTC, RDE-135A	MR-1554		1
R43	4	RES 825 OHM 1%1/8W	MR-1555		4
R44					
R68					
R69					
R37	4	RES 1.5K OHM 1%1/8W M	MR-1560		2
R51					
R4	4	RES 150 OHM 5%1/4W F	MR-277		1
R15	4	RES 100K OHM 5%1/4W F	MR-310		3
R22					
R53					
R10	4	RES 1 OHM 10%1/2W C	MR-357		1
R21	4	RES 10K OHM 5%1/4W F	MR-470		3
R52					
R71					
R14	4	RES 6.8K OHM 5%1/4W F	MR-474		1
R25	4	RES 2.7K OHM 5%1/4W F	MR-482		6
R29					
R30					
R60					
R65					
R66					
R6	4	RES 1.5K OHM 5%1/4W F	MR-483		2

TABLE 5-3
LOGIC BOARD PARTS LIST (continued)

REF NO.	LEVEL*	DESCRIPTION	PART NUMBER	REV.	QTY
R16					
R1	4	RES 1M OHM 5%1/4W F	MR-598		1
R23	4	RES 200K OHM 5%1/4W F	MR-819		2
R54					
R40	4	RES 150K OHM 5%1/4W F	MR-820		2
R57					
R17	4	RES 330 OHM 5%1/4W F	MR-822		6
R18					
R32					
R33					
R34					
R35					
R24	4	RES 1K OHM 5%1/4W F	MR-963		8
R28					
R42					
R59					
R64					
R67					
R70					
R81					
R36	4	RES 47K OHM 5%1/4W F	MR-964		2
R46					
R5	4	RES 470 OHM 5%1/4W F	MR-972		2
R11					
R7	4	RES 68K OHM 5%1/4W F	MR-976		1
R3	4	RES 4.7K OHM 5%1/4W F	MR-979		2
R45					
	4	STUD	MS-109		2
	4	SOCKET, FOR Q4—Q9	MS-165		6
	4	SOCKET,40 PIN (FOR U25)	MS-486		2
	4	SOCKET,28PIN (U22,U23,U24)	MS-523		3
U2	4	I.C. LM340T-15	MW-200		1
U4	4	I.C. LM358N	MW-246		3
U18					
U28					
U1	4	I.C. MM74C14N/B+	MW-278		1
U15	4	I.C. DM74LS74N/B+	MW-348		2
U32					
U12	4	DM74LS174N/B+	MW-350		1
U7	4	I.C. 74LSO4N/B+	MW-351		2
U9					
U14	4	I.C. SN74LS08N/B+	MW-391		1
U16	4	DM74LS157N/B+	MW-396		1
U20	4	I.C. SN74LS244N	MW-427		1
RP1	4	CENTRALAB #HC2110-473G	MW-448		2
RP2					
U30	4	I.C. DS1489P	MW-455		1
U10	4	I.C. DM74LS138/B+	MW-477		2
U11					
U25	4	I.C. 3880-4,Z80A CPU	MW-489		1
U3	4	I.C. LM7915CT	MW-490		1
U34	4	I.C. 74LS32	MW-354		1

TABLE 5-3
LOGIC BOARD PARTS LIST (continued)

REF NO.	LEVEL*	DESCRIPTION	PART NUMBER	REV.	QTY
U26	4	I.C. ITL P8255A	MW-508		1
U31	4	I.C. MC1488P	MW-530		1
U21	4	I.C. MOS Z80A-CTC/PS	MW-545		1
U17	4	I.C. PMI DAC08 EQ	MW-556		2
U27					
U33	4	I.C. ITL P8251A	MW-560		1
U24	4	RAM NMC2116Q-3N-20	MW-685		1
CR5	4	I.C. #Z1CSB1	MW-723		1
U19	4	I.C. L290 SGS	MW-809		2
U29					
U13	4	I.C. NMC9306J	MW-940		1
U8	4	I.C. Z8 8613 4K XROM	MW-949		1
	4	ASSY,HEATSINK W/XSTR.	DMP51-215	B	1
	4	HEATSINK,TRANSISTOR	DMP51-214		1
Q7	4	TRANSISTOR TIP127	MQ-83		2
Q9					
Q5	4	TRANSISTOR TIP122	MQ-84		3
Q6					
Q8					
Q4	4	REGULATOR MC7805CT	MW-201		1
	4	ROM DMPL50 /27128-300	MW-946		1
	4	I.C. 27128 16K X 8	MW-950		1
	4	ROM DMPL50 /2764-300	MW-947		1
	4	I.C. 2764-3,8K X 8	MW-827		1
	4	ROM Z8 /2732-300	MW-948		1
	4	I.C. NSC NMC27C32Q-35	MW-661		1
	4	SCHEMATIC,LOGIG BD.	DMP51-104		1

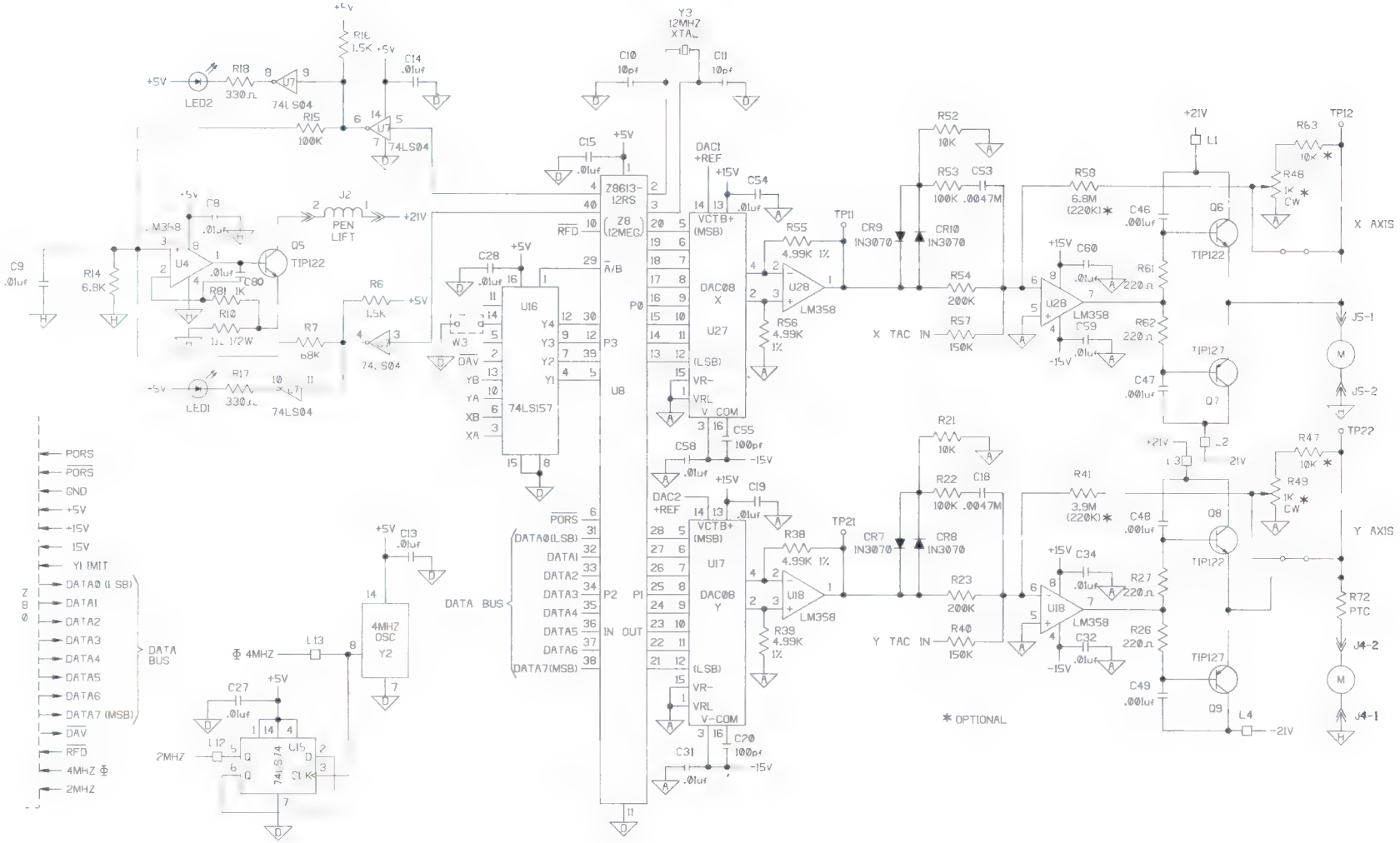


FIGURE 5-4
LOGIC BOARD SCHEMATIC (SHT. 1 OF 5)

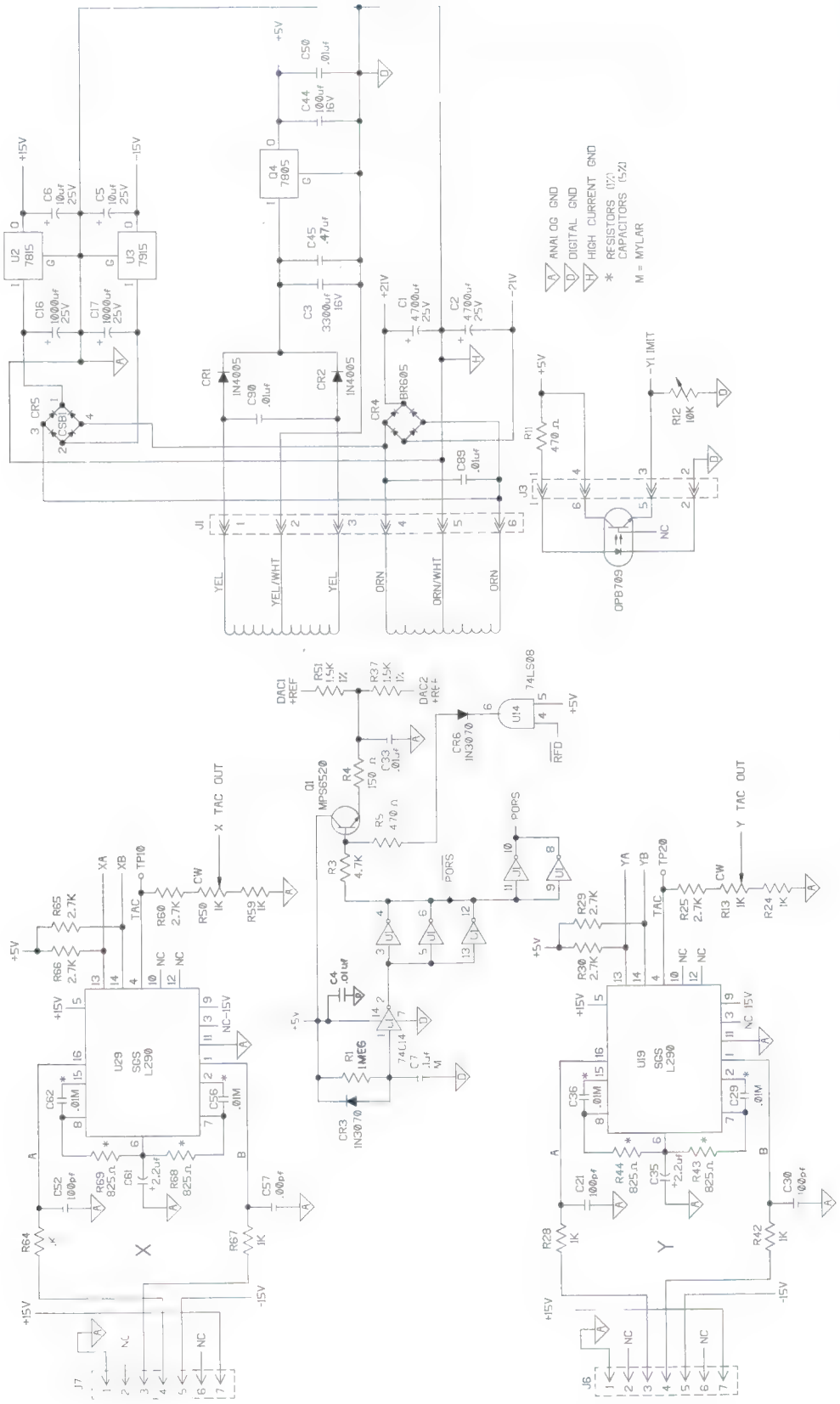


FIGURE 5-5
LOGIC BOARD SCHEMATIC (SHT. 2 OF 5)

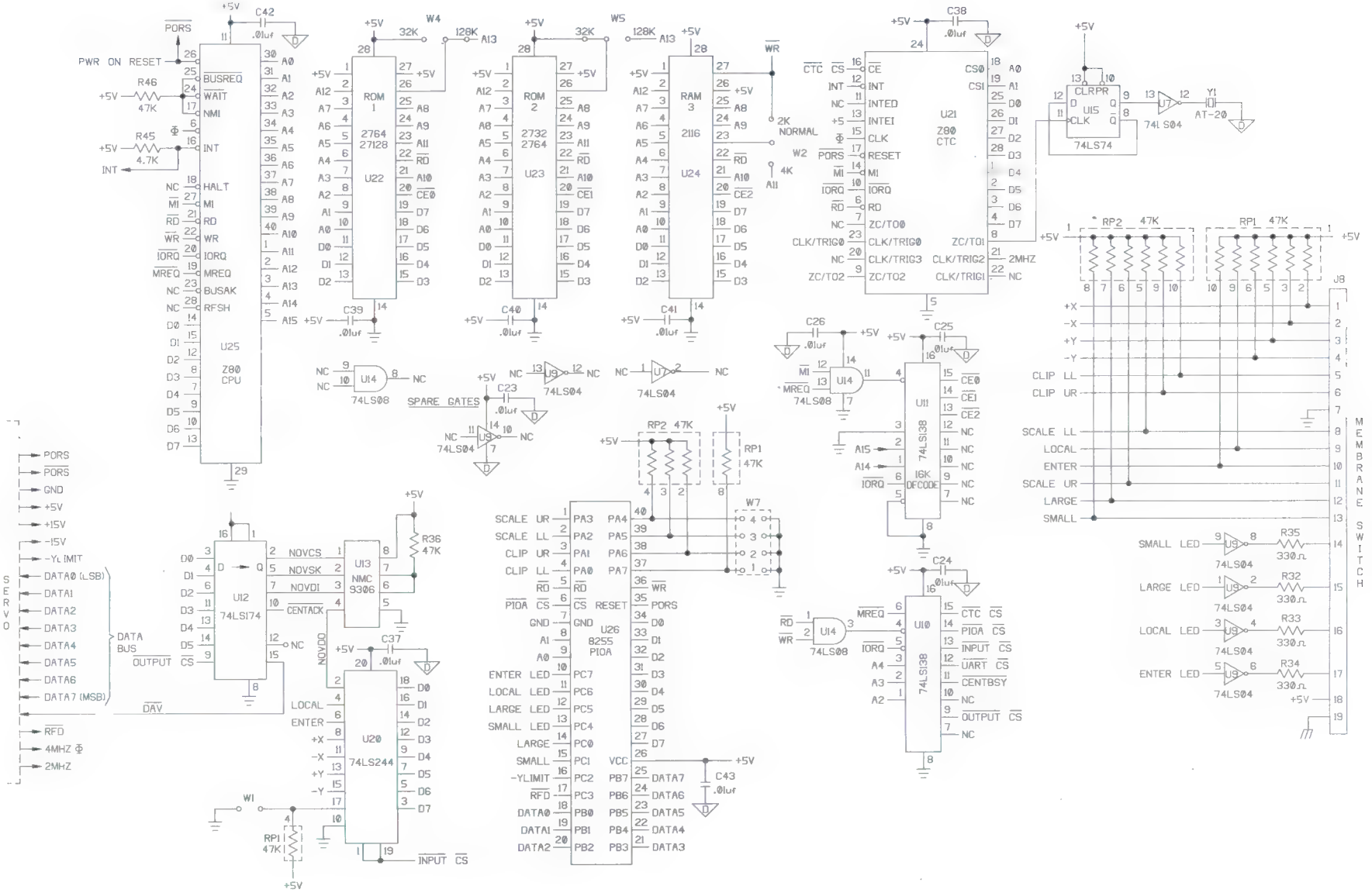


FIGURE 5-6
LOGIC BOARD SCHEMATIC (SHT. 3 OF 5)

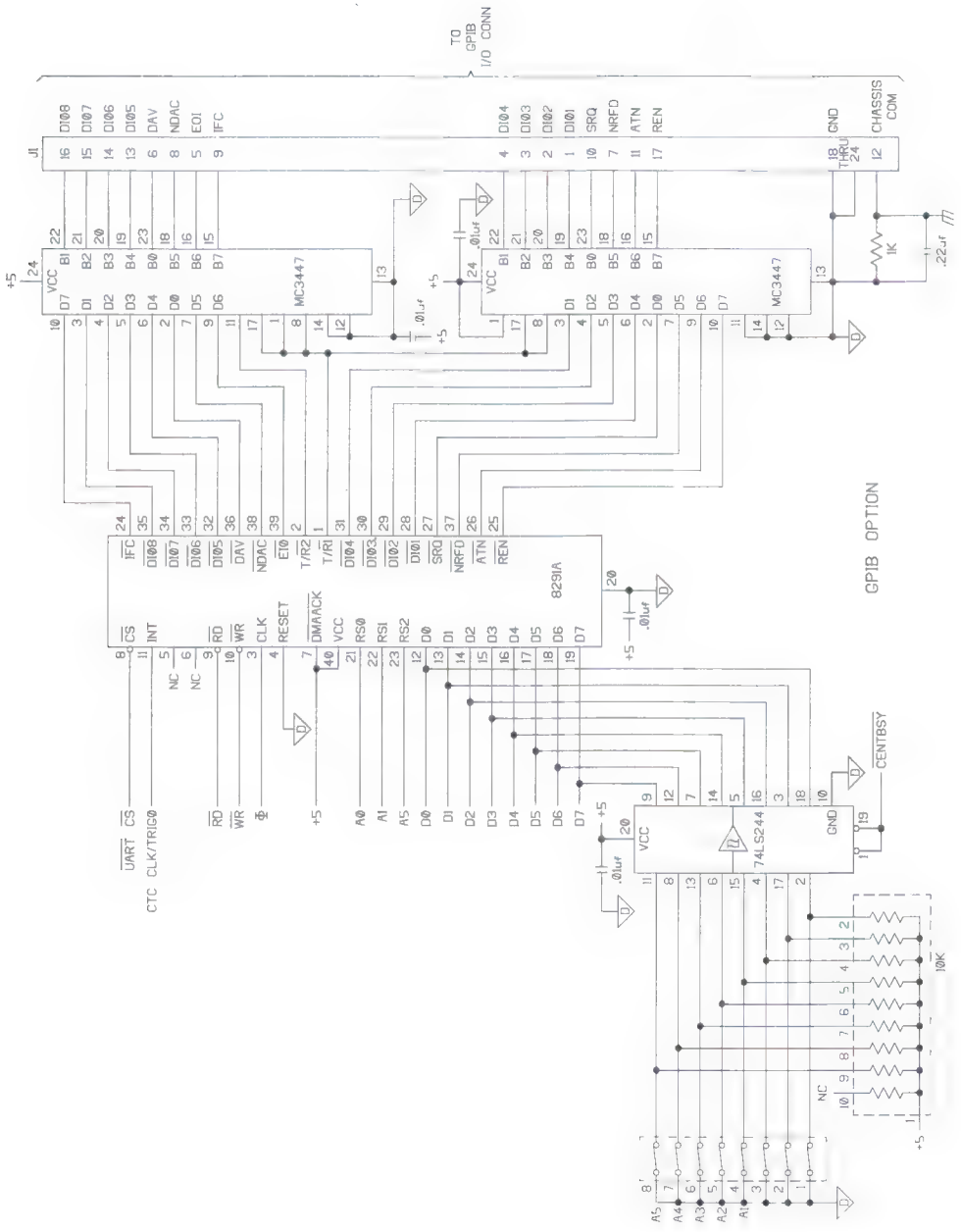


FIGURE 5-7
LOGIC BOARD SCHEMATIC (SHT. 4 OF 5)

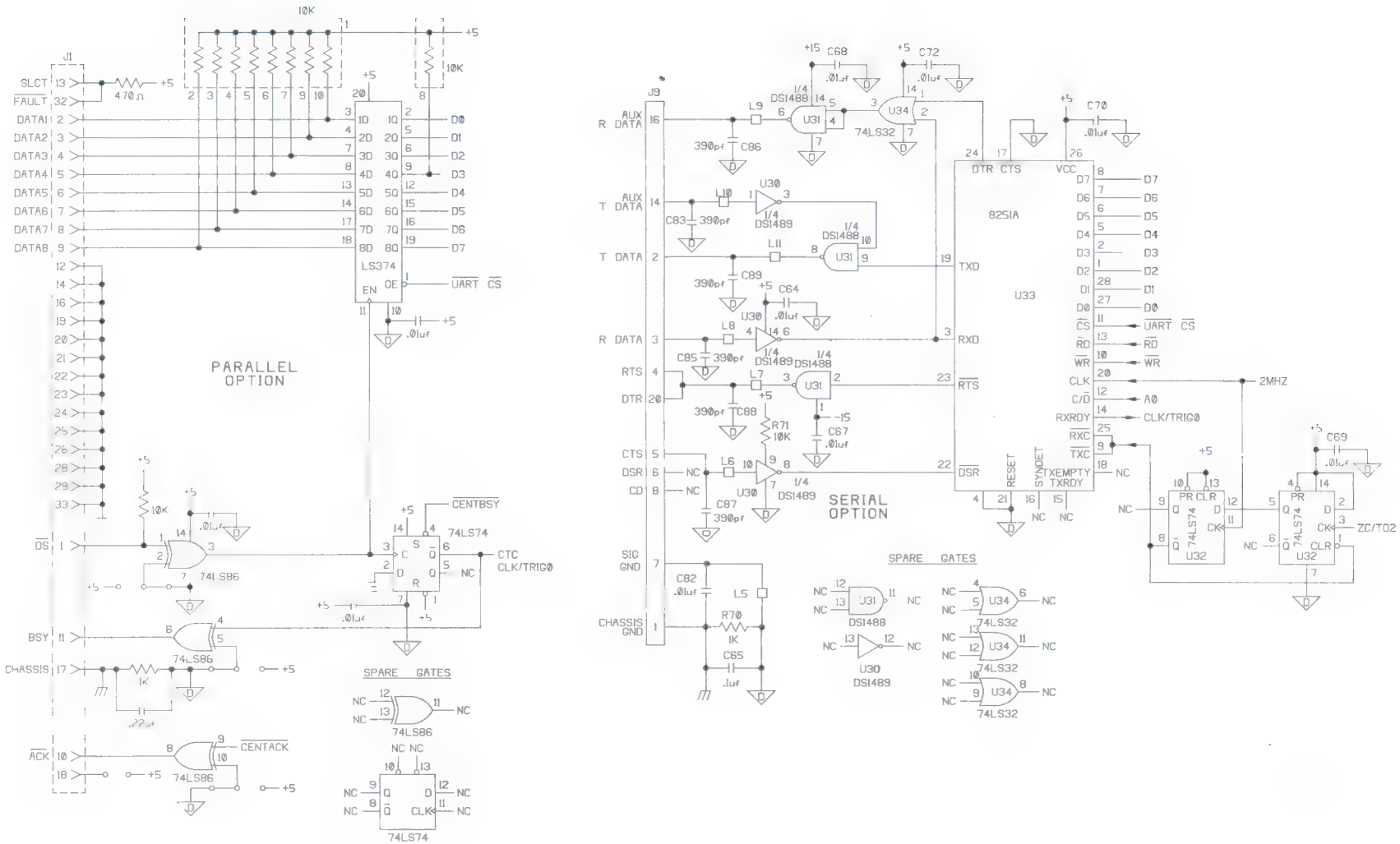


FIGURE 5-8
LOGIC BOARD SCHEMATIC (SHT. 5 OF 5)

APPENDIX A
DIGITAL PLOTTER FUNDAMENTALS

DIGITAL PLOTTER FUNDAMENTALS

After watching the plotter perform during a remote plotting session or the self-test routine, you may wonder how it "knows" where to draw the lines that create the plot. The plotter uses the properties of the Cartesian coordinate system. Two axes, customarily designated as "x" and "y," are constructed perpendicular to each other and intersect at a reference point, or origin.

As shown in Figure A-1, the positive quantities lie above and to the right of the origin. Negative quantities lie below and to the left of the origin.

The second example in Figure A-1 shows how the system is used to define the location of points on a plane. Note that the distances measured upon each axis are referenced from the origin, and the perpendicular projection of each measure defines point "A." Thus, two distances (x and y) describe the location of any position on a plane with respect to the point of reference (the origin). In digital plotting, point "A" is defined as a set of vector pairs relative to the origin. For example, x = 3, y = 4.

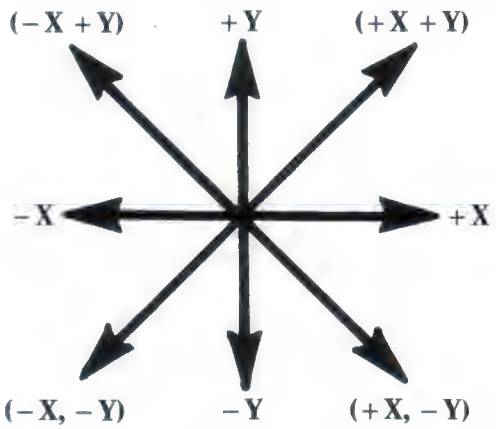
ABSOLUTE VECTOR PAIRS

In an absolute system, the area to be plotted can be thought of as a field. If it were laid out in a grid pattern corresponding to the x and y axes, then any point on the field would have a corresponding set of vector pairs. In Figure A-1, the vector pair for point "B" is x = 1, y = 7 in an absolute system.

RELATIVE VECTOR PAIRS

In a relative system, the plotting area can also be thought of as a gridded field (as in the case of an absolute system). However, rather than point "B" being based on the origin (as in an absolute system), it is RELATIVE to point "A." In a relative system, each successive set of vector pairs is relative to the last set (or point).

In other words, point "A" is based on the origin, point "B" is based on point "A," and so on. Therefore, the vector pair for point "B" in a relative system is x = -2, y = 3 (using point "A" as the reference point). Point "B" will now be the reference point for a subsequent point "C."



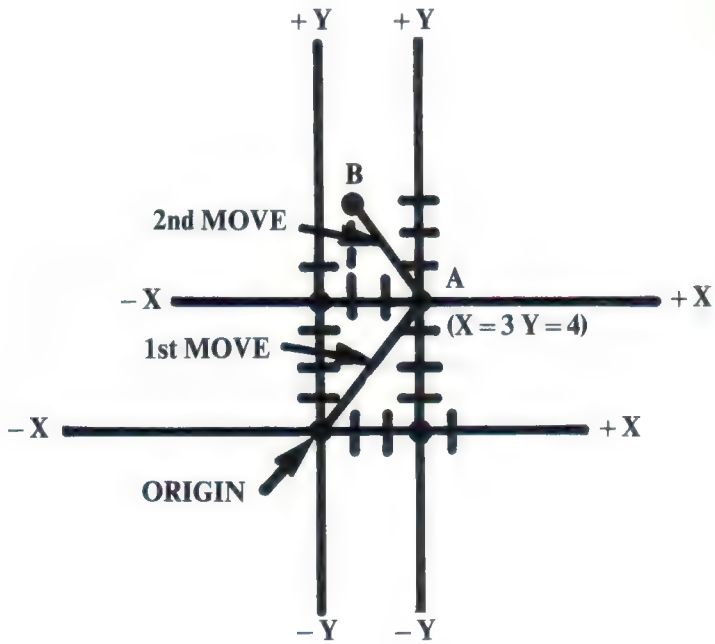


FIGURE A-1
CARTESIAN COORDINATE SYSTEM

THE INCREMENTAL PATH

The term "incremental" comes from a method used to create the graphic display. The picture, graph, or chart is developed by moving the pen carriage or paper an incremental distance (step) in response to each individual pulse received at the input connector. These input pulses are processed by circuitry in the plotter, and then applied to a motor.

A "stepper" motor (as it is more commonly called) is unlike other continuously rotating motors, since it requires a specific number of input pulses to rotate the motor shaft 360°. Stepping rates for stepper motors range from 100 to over 5000 steps per second—depending upon the motor design and the drive method used to cause stepping action.

Assume that the x and/or y axes move 0.005 inch for each input pulse. Since pulses may be received in both the x and y axes simultaneously, the distance of a single diagonal step is increased by the square root of two times the step size [$\sqrt{}$ (2 × 0.005 inch) = 0.007 inch]. This is the vector sum of two adjacent vectors. Therefore, if a +x and a +y pulse are received simultaneously, the vector sum of the two (+x and +y) will create a 45° angle.

It can be easily shown that by using the eight directions (as illustrated in the first example in Figure A-1), a line at any angle can be approximated more precisely than if only the four axial moves were used. It is the function of the computer software and/or plotter's intelligence to calculate the optimum sequence of moves for a given line slope.

Figure A-2 illustrates the incremental path generated for a typical analytic function. The magnified portion of Figure A-2 shows that the curve is actually an approximation to the exact slope at any point.

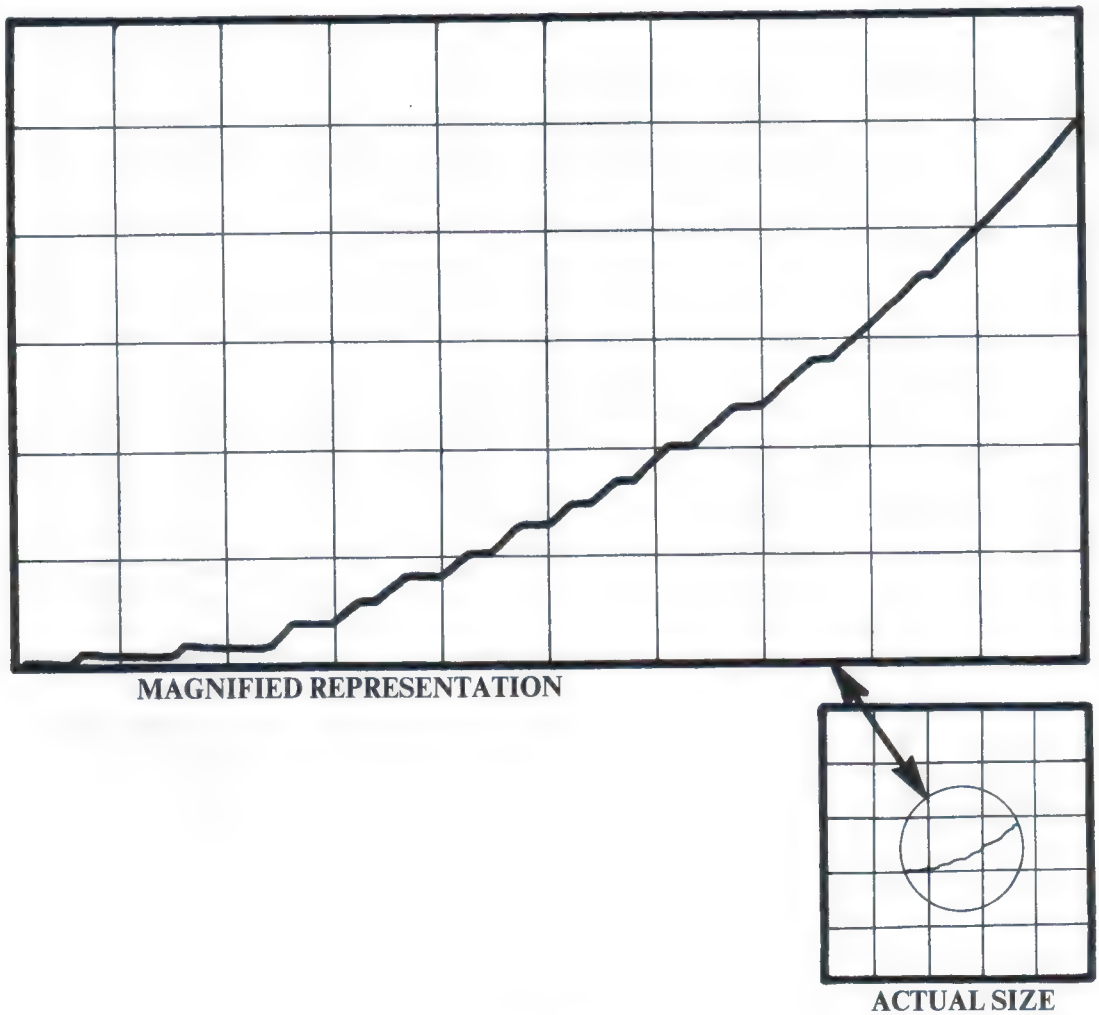


FIGURE A-2
ACTUAL AND MAGNIFIED PLOT INCREMENTS

APPENDIX B
CONTROL PANEL LED AND HORN CONDITIONS

This appendix describes the conditions which cause the Control Panel lamps (LEDs) to illuminate and the Plotter's horn to "beep."

LED INDICATOR(S)	PLOTTER CONDITION
SMALL or LARGE lamp on.	Small or large chart format in STATE 0.
SMALL or LARGE lamp on and LOCAL lamp on.	Small or large chart format in STATE 1.
SMALL or LARGE lamp on and ENTER lamp on.	Small or large chart format in STATE 2.
SMALL or LARGE lamp on and LOCAL and ENTER lamps on.	Small or large chart format in STATE 3.
SMALL and ENTER lamps on, but Plotter will not reset or respond to remote activity.	Menu mode (no resets allowed). Exit Menu mode by pressing SCALE UR.
SMALL or LARGE lamp on, LOCAL lamp on, and ENTER lamp flashing.	Digitizer mode.
SMALL or LARGE lamp on and LOCAL lamp flashing.	Illegal window corner entry in local mode. Return to STATE 3 and correct window entry.
SMALL and LARGE lamps on and Plotter appears jammed.	Bad pen-axis vector trapped. Turn power off (for five seconds) and on.
ENTER lamp remains on after reset or Self-Test.	ROM check sum failure. Service required.
LOCAL lamp remains on after reset or Self-Test.	RAM read/write failure. Service required.
ENTER and LOCAL lamps remain on after reset or Self-Test.	NVRAM read/write failure. Service required.
ENTER and LOCAL lamps flashing.	NVRAM read/write failure. Service required.

CONTROL PANEL LED AND HORN CONDITIONS

HORN "BEEPS"	EVENT
One	A valid operation is entered at the front Control Panel.
One	Any action initiated from the host which causes the Plotter to switch from remote to local, such as the DM/PL ED and EL commands or a new pen pause.
One	The Plotter detects an error in a remote command which causes a default value to become current. For example, the Plotter receives an invalid DM/PL W command which activates the window's default value.

GLOSSARY

ABSOLUTE VECTOR PAIR: A coordinate set that references a set origin point to determine a position on a plane.

ACCURACY: The plotter's ability to produce a plot exactly to the dimensions specified by an input program or command.

ADDRESSABLE RESOLUTION: A software capability in the plotter that allows a computer to select or change (program) the resolution (step size) of the plotter during remote plotting sessions.

ASCII: Abbreviation for American Standard Code for Information Interchange.

ASYNCHRONOUS SERIAL DATA COMMUNICATIONS: A serial I/O protocol in which each byte transmitted is self-sufficient and does not require a timing sequence.

BAUD RATE: The rate in bits per second at which information is transmitted over a serial link.

BUFFER: A storage circuit that compensates for differences in data flow between two computing devices.

BYTE: A sequence of adjacent binary digits (bits), operated upon as a unit in a computer.

COMMAND STRING: A collection of individual computer or peripheral commands that initiate or control predetermined operations.

COORDINATE SET (x,y): A pair of numeric specifiers that determine a single position on the plane of a coordinate axes system. A coordinate set can determine a position by either referencing a set origin point (absolute) or the position of the last vector pair (relative).

DATA: A general term for the numbers, letters, and symbols that serve as input or output for a computing device.

DIP (SWITCH): Abbreviation for dual in-line package.

DIGITIZER: An electronic device that converts graphic information into digital computer data.

HALF DUPLEX: A communication channel capable of transmission in both directions but in only one direction at a time.

HANDSHAKING: The process of transferring information between two devices in a synchronized manner at a rate acceptable to both devices (this process may be in either hardware or software).

HARDWARE: The electronic circuitry in a system.

HEXADECIMAL: A notation in the scale of 16, using alphanumeric digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F.

I/O: Abbreviation for Input and Output data.

IEEE-488 GPIB: Abbreviation for Institute of Electrical and Electronic Engineers #488, General Purpose Interface Bus.

INCREMENT: The smallest possible unit of plotter movement.

INTERFACE: The boundary between two devices.

MODEM PORT: A connector on the plotter for cable interface with a host computer.

POINT MODE: An operating mode of a digitizer where coordinate (x,y) data is digitized one point at a time upon local or remote command.

PROMPT CODE: A signal from a computer to a peripheral that instructs the device to execute the input data.

RAM: Abbreviation for Random Access Memory circuitry.

REPEATABILITY (%). The percent of fluctuation that will occur if the plotter produces the same plot design successively.

RELATIVE VECTOR PAIR: A coordinate set that references the location of the last vector pair to determine the next position on a plane.

ROM: Abbreviation for Read Only Memory circuitry.

TERMINAL PORT: A connector on the plotter for cable interface with a CRT terminal.

NOTES

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8500 Cameron Rd., Austin, TX 78753 □ (512) 835-0900
P.O. Box 15720, Austin, TX 78761

Europe: Belgium NV, Rochesterlaan 6, 8240 Gistel, Belgium
Tel 059-27-74-45 TLX 846-81399

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